Data Committee Meeting Agenda

Wednesday, November 28, 2018 @ 1:00 PM
Michigan Department of Transportation Aeronautics Building
1st Floor Auditorium
2700 Port Lansing Road
Lansing, Michigan

1. **Welcome - Call to Order – Introductions**

2. **Public Comments on Non-Agenda Items**

3. **Consent Agenda**
   - 3.1 Approval of the 9-26-18 Data Committee Meeting Minutes ***(Action – Attachment 1)***
   - 3.2 TAMC Budget Update ***(Attachment 2)***

4. **Presentations** – *Center for Technology & Training: Manty/Torola*
   - 4.1. 2018 Michigan Local Agency Pavement Treatment Life Study ***(Attachment 3)***
   - 4.2. Analysis of TAMC Investment Reporting Data for Network Level Modeling on the Locally Owned Road System in Michigan ***(Attachment 4)***

5. **Review & Discussion Items:**
   - 5.1. Status of 2018 PASER Data Collection – *Belknap* ***(Attachment 5)***
     - 5.1.1. Federal Aid (Paved & Unpaved)
     - 5.1.2. Non-Federal Aid
   - 5.2. Integration of Road Improvement Data into Annual PASER Survey – *Belknap*
   - 5.3. Schedule of Asset Management Plans – *McEntee/Belknap* ***(Attachment 6)***
   - 5.4. Investment Reporting: Review Process of Future Projects & Three-year Plan Requirements – *Start/Belknap*
   - 5.5. Website/Dashboard/Investment Reporting Tool (IRT) Update – *CSS*
     - 5.5.1. Ownership vs. Jurisdiction in Data Conversation
     - 5.5.2. Creation of Dashboards for Top 123 Agencies Under Public Act 325
     - 5.5.3. Culvert Data Integration of Interactive Map/Dashboards/IRT

6. **Public Comments**

7. **Member Comments**

8. **Adjournment**

The next TAMC Data Committee Meeting is scheduled for December 19, 2018 at the MDOT Aeronautics Building, 2nd Floor Commission Room, 2700 Port Lansing Road, Lansing, Michigan

Meeting Telephone Conference Line: 1-877-336-1828 Access Code: 8553654#

Data Committee Members: Committee Chair: Bill McEntee, CRA – Vice Chair: Jon Start, MTPA
Bob Slattery, MML – Jennifer Tubbs, MTA – Rob Surber, MCSS

TRANSPORTATION ASSET MANAGEMENT COUNCIL
DATA COMMITTEE
September 26, 2018 at 1:00 p.m.
MDOT Aeronautics Building, 2nd Floor Commission Room
2700 Port Lansing Road
Lansing, Michigan
MINUTES

****Frequently Used Acronyms Attached**

Members Present:
Bill McEntee, CRA – Chair
Jonathan Start, MTPA/KATS
Jennifer Tubbs, MTA, via Telephone
Bob Slattery, MML
Rob Surber, DTMB/CSS

Support Staff Present:
Niles Annelin, MDOT
Gil Chesbro, MDOT
Cheryl Granger, DTMB/CSS, via Telephone
Gloria Strong, MDOT
Roger Belknap, MDOT
Tim Colling, MTU, via Telephone
Polly Kent, MDOT

Members Absent:
None

Public Present:
Jim Snell, Tri-County Regional Planning Commission
Laura Tschirhart, Tri-County Regional Planning Commission
Christian Zimmer, MDOT

1. Welcome – Call-to-Order – Introductions:
The meeting was called-to-order at 1:05 p.m. Everyone present was introduced and welcomed to the meeting.

2. Public Comments on Non-Agenda Items:
None

3. Consent Agenda:

3.1. – Approval of the August 22, 2018 Data Committee Meeting Minutes - *Action Item* (Attachment 1)

Motion: J. Start made a motion to approve the August 22, 2018, meeting minutes; J. Tubbs seconded the motion. The motion was approved by all members present.

3.2. – TAMC Budget Update (Attachment 2)
An updated financial report (09/20/2018) was provided to the committee.

4. Election of Committee Chair and Vice Chair:
J. Tubbs nominated B. McEntee to continue as Chair of the TAMC Data Committee; J. Start seconded the nomination. All members approved the re-election of Bill McEntee as the TAMC Data Committee Chair.

J. Tubbs nominated J. Start for the position of Vice Chair of the TAMC Data Committee; B. McEntee seconded the nomination; All members approved J. Start's election as the TAMC Data Committee Vice Chair.

5. Review and Discussion Items:

5.1. – Volatility of Condition of Federal-Aid Paved County Roads Update – G. Chesbro

G. Chesbro did not do Volatility of Conditions data analysis. He has revised his graphs from last Data Committee Meeting. These are changed graphs of the parallel plots - A copy of the Paved Fed-Aid Eligible County Roads (Recharge, Population, Pop. Density, AVMT, Lane Miles, Bridges, % Good & Fair), Recharge vs Road Condition by County (Condition: % Good & Fair), Bridges vs Road Condition by County (Condition: % Poor), dated September 26, 2018, was shared with the Committee and discussed.

5.2. – Integration of Road Improvement Data into Annual PASER Survey – J. Snell

J. Snell addressed the TAMC Data Committee to see if it is possible to do a final improvements survey towards the end of the data collection season that accounts for all road improvements and make things more efficient. He stated that jurisdictions are hesitant to do their evaluations in the spring. If they do them in the spring of an odd year it causes problems with their deterioration curves and their billing. There is work that goes on during the calendar year and it would be better to do a final improvement survey at the end of the data collection season. He would like a feature added to Roadsoft to insert the construction as it is done. This way they could do it in the office instead of sending a team back out. This information could then be added to the IRT.

Per T. Colling, the data set in Roadsoft is set up based on field ratings only. It would be possible to export projects into the Laptop Data Collector (LDC) and then rate them in the LDC.

The Committee discussed a variety of issues and consequences. Some of the issues were: Can CSS handle two submissions each year? Is it within the budget? Will the deterioration matrix be thrown off? Should TAMC require all regions to do this? It is unclear if any other regions are currently doing this. Some may already be collecting this information. How much more work will be required of the regions to put in a second submission? CSS feels this could be an automated process and would have to look into it. Does TAMC want to promote this as a best practice or make it a mandatory practice? Having to wait until possibly November, in order to collect and submit road improvement data may be too close to doing the annual report. TAMC would need to create a procedure for doing this.

The committee agreed this is an area where TAMC needs to give more direction, but not during this data collection season. The committee felt that TAMC cannot make such a policy change at this time, but could at least ask the regions if they already collect this information. It was suggested that R. Belknap ask the regions about this during his monthly Regional Planning Call. R. Belknap will pull together a list of questions that he will ask the regions on his next regional planning call. G. Chesbro, CSS, and MTU will report back at the November 28, 2018 meeting, if this can be done and how they can make it as easy as possible for agencies to submit that data. The Data Committee will review the information provided from everyone at the November meeting and possibly go to full Council in December with a recommendation.

Action Item: R. Belknap will pull together a list of questions that he will ask the regions on his next regional planning call and report back to Data Committee at the November 28, 2018 Data Committee meeting.

Action Item: G. Chesbro, CSS, and MTU will report back at the November 28, 2018 meeting, if this can be done and how they can make it as easy as possible for agencies to submit that data.

Action Item: The Data Committee will review the information provided from everyone at the November meeting and possibly go to full Council in December with a recommendation.

5.3. – Asset Management Plans and Public Act 325 – B. McEntee/R. Belknap (Attachment 3)
This starts the process of TAMC addressing their new responsibilities within Public Act 325. A listing of the Michigan's Top 123 Road Agencies Asset Management Plan Status was provided, combined with a list of Asset Management Plans that TAMC has received. Some of the plans are already expired, some will expire in 2019 and 2020; one expires in 2026. Another hand out distributed was a map showing where each of the agencies that have submitted an asset management plan are located. Some agencies have submitted their plans through the IRT. In a letter that went out to planning and local agencies, TAMC asked for volunteers to be in the first group to submit asset management plans. TAMC has not received any volunteers. TAMC must pick 41 agencies for the first round. Almost none of the previously submitted asset management plans have all of the mandatory elements. Data Committee will need an asset management plan template that agencies can complete that provides all seven (7) of the requirements. MTU is working on that template. MTU will hold four (4) classes in December and inform local agencies that all of the elements are not in the template and a task is in the 2019 work plan to create a template that meets TAMCs requirements. The first due date for the asset management plans is 2021. Agencies actually have two years before the final asset plan is due. If they have their plan in, they have time to have it reviewed and changes made before the final plan has to be submitted. They have to show progress by 2025. This gives them a longer period to make any kind of corrections; less pressure before the hard enforcement deadline. There may be a way to possibly do this regionally. TAMC will need to coordinate with the Water Asset Management Council (WAMC) as they require a water asset management plan also. Data Committee does not know enough to make a recommendation at this time.

5.4. – Update on Asset Management Culvert Pilot Project – B. McEntee
The final Culvert Pilot Project Report was recently sent to Rebecca Curtis, TAMC Bridge Committee Chair. There were approximately 50,000 culverts inspected and data submitted. Several of the agencies have gone out on their own after the deadline and collected more culvert data using their own funds. There were some challenges, such as the need for a more simplified rating system, storage and maintenance of Culvert data, etc., that showed up in the report and MTU has documented them for future reference. It will be discussed in the future how TAMC can use culvert data that was submitted.

TAMC support staff is checking with MDOT Finance on how TAMC can possibly keep and encumber the relatively small amount of left-over funds from the culvert pilot project for further use in FY 2019.

5.5. – Inventory-Based Rating System Update/Level of Implementation – B. McEntee/T. Colling
B. McEntee would like the Data Committee to be thinking about what TAMC needs to do in the next fiscal year in support of the IBR. Hopefully, in the next annual report TAMC can have a development and usage section of the IBR. They could talk about the federal aid eligible unpaved system. They only report on condition on the paved federal aid system. Currently, TAMC does not know how much data for unpaved non-federal aid roads is available, as it is at the discretion of the agencies to submit this data. TAMC may want to report where they are with this for the annual report. It was requested that R. Belknap ask during his next Regional Planning Call how many of the agencies collect this information and report back to Data Committee.

Action: R. Belknap to ask the during his next Regional Planning Call how many of the agencies collect unpaved non-federal aid road data and report back to Data Committee.

5.6. – Website/Dashboard/Investment Reporting Tool Update – C. Granger
C. Granger gave an update on what CSS is currently working on for TAMC. The Google Analytics piece is ready to go into the dashboards. For the WAMC/TAMC Website CSS is still working on this. WAMC will also eventually have a dashboard. The WAMC dashboard will be created once WAMC gets more data.

6. Public Comments:
None

7. Member Comments:
B. McEntee shared some available data sets that are within the Highway Statistics Reports. They are in Excel and PDF files if people would like to use them. He also shared some information on federal requirements for asset management plans and the differences between Michigan and other states.

8. Adjournment:

Motion: J. Start made a motion to adjourn the meeting; B. Slattery seconded the motion. The motion was approved by all members present. The meeting adjourned at 2:59 p.m.. The next meeting will be held November 28, 2018, at 1:00 p.m., MDOT Aeronautics Building, 2nd Floor Commission Conference Room, 2700 Port Lansing Road, Lansing.

TAMC FREQUENTLY USED ACRONYMS:	
AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
ACE	ADMINISTRATION, COMMUNICATION, AND EDUCATION (TAMC COMMITTEE)
ACT-51	PUBLIC ACT 51 OF 1951-DEFINITION: A CLASSIFICATION SYTEM DESIGNED TO DISTRIBUTE MICHIGAN'S ACT 51 FUNDS. A ROADWAY MUST BE CLASSIFIED ON THE ACT 51 LIST TO RECEIVE STATE MONEY.
ADARS	ACT 51 DISTRIBUTION AND REPORTING SYSTEM
BTP	BUREAU OF TRANSPORTATION PLANNING (MDOT)
CPM	CAPITAL PREVENTATIVE MAINTENANCE
CRA	COUNTY ROAD ASSOCIATION (OF MICHIGAN)
CSD	CONTRACT SERVICES DIVISION (MDOT)
CSS	CENTER FOR SHARED SOLUTIONS
DI	DISTRESS INDEX
ESC	EXTENDED SERVICE LIFE
FAST	FIXING AMERICA'S SURFACE TRANSPORTATION ACT
FHWA	FEDERAL HIGHWAY ADMINISTRATION
FOD	FINANCIAL OPERATIONS DIVISION (MDOT)
FY	FISCAL YEAR
GLS REGION V	GENESEE-LAPEER-SHIAWASSEE REGION V PLANNING AND DEVELOPMENT COMMISSION
GVMC	GRAND VALLEY METRO COUNCIL
HPMS	HIGHWAY PERFORMANCE MONITORING SYSTEM
IBR	INVENTORY BASED RATING
IRI	INTERNATIONAL ROUGHNESS INDEX
IRT	INVESTMENT REPORTING TOOL
KATS	KALAMAZOO AREA TRANSPORTATION STUDY
KCRC	KENT COUNTY ROAD COMMISSION
LDC	LAPTOP DATA COLLECTORS
LTAP	LOCAL TECHNICAL ASSISTANCE PROGRAM
MAC	MICHIGAN ASSOCIATION OF COUNTIES
MAP-21	MOVING AHEAD FOR PROGRESS IN THE 21ST CENTURY (ACT)
MAR	MICHIGAN ASSOCIATION OF REGIONS
MDOT	MICHIGAN DEPARTMENT OF TRANSPORTATION
MDTMB	MICHIGAN DEPARTMENT OF TECHNOLOGY, MANAGEMENT AND BUDGET
MIC	MICHIGAN INFRASTRUCTURE COUNCIL
MITA	MICHIGAN INFRASTRUCTURE AND TRANSPORTATION ASSOCIATION
MML	MICHIGAN MUNICIPAL LEAGUE

MPO	METROPOLITAN PLANNING ORGANIZATION
MTA	MICHIGAN TOWNSHIPS ASSOCIATION
MTF	MICHIGAN TRANSPORTATION FUNDS
MTPA	MICHIGAN TRANSPORTATION PLANNING ASSOCIATION
MTU	MICHIGAN TECHNOLOGICAL UNIVERSITY
NBI	NATIONAL BRIDGE INVENTORY
NBIS	NATIONAL BRIDGE INSPECTION STANDARDS
NFA	NON-FEDERAL AID
NFC	NATIONAL FUNCTIONAL CLASSIFICATION
NHS	NATIONAL HIGHWAY SYSTEM
PASER	PAVEMENT SURFACE EVALUATION AND RATING
PNFA	PAVED NON-FEDERAL AID
PWA	PUBLIC WORKS ASSOCIATION
QA/QC	QUALITY ASSURANCE/QUALITY CONTROL
RCKC	ROAD COMMISSION OF KALAMAZOO COUNTY
ROW	RIGHT-OF-WAY
RPA	REGIONAL PLANNING AGENCY
RPO	REGIONAL PLANNING ORGANIZATION
SEMCOG	SOUTHEAST MICHIGAN COUNCIL OF GOVERNMENTS
STC	STATE TRANSPORTATION COMMISSION
STP	STATE TRANSPORTATION PROGRAM
TAMC	TRANSPORTATION ASSET MANAGEMENT COUNCIL
TAMCSD	TRANSPORTATION ASSET MANAGEMENT COUNCIL SUPPORT DIVISION
TAMP	TRANSPORTATION ASSET MANAGEMENT PLAN
TPM	TRANSPORTATION PERFORMANCE MEASURES
UWP	UNIFIED WORK PROGRAM
WAMC	WATER ASSET MANAGEMENT COUNCIL

S:/GLORIASTRONG/TAMC FREQUENTLY USED ACRONYMS.07.2018.GMS

Attachment 2
11/21/18

TAMC Budget Expenditure Report

Michigan Transportation Asset Management Council

	(most recent invoice date)	FY17 Budget $	FY17 Actual Balance	FY18 Budget $	FY18 Year to Date Spent	FY18 Year to Date Balance	FY19 Budget $	FY19 Year to Date Spent	FY19 Year to Date Balance
I. Data Collection & Regional-Metro Planning Asset Management Progam									
Battle Creek Area Transporation Study	4 qtr 18	$ 20,000.00	$ 4,555.97	$ 20,500.00	$ 20,213.36	$ 286.64	$ 20,500.00	$ -	$ 20,500.00
Bay County Area Transportation Study	3 qtr 18	$ 20,000.00	$ 9,205.58	$ 21,100.00	$ 6,724.59	$ 14,375.41	$ 21,100.00	$ -	$ 21,100.00
Central Upper Peninsula Planning and Development	3 qtr 18	$ 40,471.00	$ -	$ 47,000.00	$ 24,395.80	$ 22,604.20	$ 47,000.00	$ -	$ 47,000.00
East Michigan Council of Governments	OCT	$ 95,995.00	$ 15,902.25	$ 111,000.00	$ 81,559.65	$ 29,440.35	$ 111,000.00	$ 5,159.62	$ 105,840.38
Eastern Upper Peninsula Regional Planning & Devel.	4 qtr 18	$ 20,000.00	$ -	$ 23,100.00	$ 23,100.00	$ -	$ 23,100.00	$ -	$ 23,100.00
Genesee Lapeer Shiawasse Region V Planning Com.	JULY	$ 39,423.00	$ 2,250.94	$ 46,000.00	$ 29,609.18	$ 16,390.82	$ 46,000.00	$ -	$ 46,000.00
Grand Valley Metropolitan Council	4 qtr 18	$ 20,000.00	$ 1,025.36	$ 25,000.00	$ 12,060.69	$ 12,939.31	$ 25,000.00	$ -	$ 25,000.00
Kalamazoo Area Transportation Study	AUGUST	$ 20,000.00	$ 871.89	$ 22,000.00	$ 15,451.33	$ 6,548.67	$ 22,000.00	$ -	$ 22,000.00
Macatawa Area Coordinating Council	3 qtr 18	$ 20,000.00	$ 12,594.34	$ 20,200.00	$ 4,523.35	$ 15,676.65	$ 20,200.00	$ -	$ 20,200.00
Midland Area Transportation Study	3 qtr 18	$ 20,000.00	$ 2,339.46	$ 21,000.00	$ 3,981.92	$ 17,018.08	$ 21,000.00	$ -	$ 21,000.00
Northeast Michigan Council of Governments	AUGUST	$ 43,426.45	$ -	$ 46,000.00	$ 46,000.00	$ -	$ 46,000.00	$ -	$ 46,000.00
Networks Northwest	SEPT	$ 61,316.00	$ -	$ 72,000.00	$ 71,915.46	$ 84.54	$ 72,000.00	$ -	$ 72,000.00
Region 2 Planning Commission	3 qtr 18	$ 37,940.00	$ 13,196.44	$ 42,000.00	$ 18,368.33	$ 23,631.67	$ 42,000.00	$ -	$ 42,000.00
Saginaw County Metropolitan Plannning Commission	3 qtr 18	$ 20,000.00	$ 8,414.71	$ 22,200.00	$ 17,495.94	$ 4,704.06	$ 22,200.00	$ -	$ 22,200.00
Southcentral Michigan Planning Commission	JULY	$ 53,162.00	$ 16,246.33	$ 57,300.00	$ 26,240.09	$ 31,059.91	$ 57,300.00	$ -	$ 57,300.00
Southeast Michigan Council of Governments	OCT	$ 135,680.00	$ 0.40	$ 174,000.00	$ 174,000.00	$ -	$ 174,000.00	$ 9,816.07	$ 164,183.93
Southwest Michigan Planning Commission	4 qtr 18	$ 37,030.00	$ -	$ 41,000.00	$ 41,000.00	$ -	$ 41,000.00	$ -	$ 41,000.00
Tri-County Regional Planning Commission	4 qtr 18	$ 33,786.00	$ -	$ 40,000.00	$ 21,680.54	$ 18,319.46	$ 40,000.00	$ -	$ 40,000.00
West Michigan Regional Planning Commission	SEPT	$ 82,467.00	$ -	$ 91,000.00	$ 55,428.20	$ 35,571.80	$ 91,000.00	$ -	$ 91,000.00
West Michigan Shoreline Regional Development Com.	SEPT	$ 46,781.56	$ 636.55	$ 54,000.00	$ 51,333.45	$ 2,666.55	$ 54,000.00	$ -	$ 54,000.00
Western Upper Peninsula Regional Planning & Devel.	3 qtr 18	$ 34,867.00	$ 19.47	$ 40,000.00	$ 18,657.04	$ 21,342.96	$ 40,000.00	$ -	$ 40,000.00
MDOT Region Participation & PASER Quality Control	10/14/18	$ 62,750.00	$ (22,587.50)	$ 80,000.00	$ 52,914.97	$ 27,085.03	$ 91,440.00	$ -	$ 91,440.00
Fed. Aid Data Collection & RPO/MPO Program Total		**$ 965,095.01**	**$ 64,672.19**	**$ 1,116,400.00**	**$ 816,653.89**	**$ 299,746.11**	**$ 1,116,400.00**	**$ 14,975.69**	**$ 1,101,424.31**
PASER PNFA Data Collection Total		**$ 40,760.39**	**$ -**	***(FY18 PNFA Moved Into Data Collection Program Above)***			***(FY19 PNFA Moved Into Data Collection Program Above)***		
III. TAMC Central Data Agency (MCSS)									
Project Mgmt	9/14/18	$ 37,800.00	($2,264.00)	$ 42,000.00	$ 46,585.00	$ (4,585.00)	$ 42,000.00	$ -	$ 42,000.00
Data Support /Hardware/Software	9/14/18	$ 60,200.00	$1,367.00	$ 68,800.00	$ 67,800.00	$ 1,000.00	$ 68,000.00	$ -	$ 68,000.00
Application Development / Maintenance / Testing	9/14/18	$ 83,280.00	$5,042.00	$ 114,475.00	$ 115,250.00	$ (775.00)	$ 114,000.00	$ -	$ 114,000.00
Help Desk / Misc Support	9/14/18	$ 66,600.00	$948.00	$ 70,200.00	$ 68,200.00	$ 2,000.00	$ 70,000.00	$ -	$ 70,000.00
Training	9/14/18	$ 27,600.00	($1,533.00)	$ 34,950.00	$ 24,850.00	$ 10,100.00	$ 34,960.00	$ -	$ 34,960.00
Data Access / Reporting	9/14/18	$ 47,155.00	$1,459.00	$ 49,575.00	$ 52,175.00	$ (2,600.00)	$ 49,600.00	$ -	$ 49,600.00
FY17 Off Budget: IRT Re-write - $241,000	9/30/17	*$ 241,040.00*	*$ (18,983.00)*						
TAMC Central Data Agency (MCSS) Total		**$ 322,635.00**	**$ 5,019.00**	**$ 380,000.00**	**$ 374,860.00**	**$ 5,140.00**	**$ 378,560.00**	**$ -**	**$ 378,560.00**
IV. TAMC Training & Education (MTU) Calendar Year Z1	11/125/18	**$ 210,000.00**	**$ 1,341.10**	**$ 235,000.00**	**$ 140,622.07**	**$ 94,377.93**	**$ 220,000.00**	**$ -**	**$ 220,000.00**
V. TAMC Activities (MTU) Z15/R1	9/18/18	**$ 70,000.00**	**$ 9,746.50**	**$ 115,000.00**	**$ 114,089.32**	**$ 910.68**	**$ 120,000.00**	**$ -**	**$ 120,000.00**
VI. TAMC Expenses									
Fall Conference Expenses	12/8/17	$ 6,000.00		$ 10,000.00	$ 7,269.00		$ 10,000.00	$ -	
Fall Conf. Attendence Fees + sponsorship Fees	12/8/17	$ -		$ -	$ 4,405.00		$ -	$ -	
Net Fall Conference	12/8/17	$ 8,625.00	$ 312.60	$ 14,405.00	$ 7,269.00	$ 7,136.00	$ 10,000.00	$ -	$ 10,000.00
Spring Conference Expenses	8/17/18	$ 8,000.00	$ -	$ 10,000.00	$ 7,439.36		$ 10,000.00	$ -	
Spring Conf. Attendence Fees + sponsorship Fees	8/17/18	$ -	$ -	$ -	$ 8,350.00		$ -	$ -	
Net Spring Conference	8/17/18	$ 14,140.00	$ 7,418.20	$ 18,350.00	$ 7,439.36	$ 10,910.64	$ 10,000.00	$ -	$ 10,000.00
Other Council Expenses	9/28/18	$ 3,915.29	$ (4,567.95)	$ 10,000.00	$ 7,301.72	$ 2,698.28	$ 10,000.00	$ -	$ 10,000.00
TAMC Expenses Total		**$ 26,680.29**	**$ 3,162.85**	**$ 42,755.00**	**$ 22,010.08**	**$ 20,744.92**	**$ 30,000.00**	**$ -**	**$ 30,000.00**
VII. Culvert Pilot Project									
Central Data Agency (MCSS)	10/16/18	$ -	$ -	$ 15,000.00	$ 9,312.00	$ 5,688.00	$ -	$ -	$ -
MTU Project Management	9/18/18			$ 172,100.00	$ 150,000.00	$ 22,100.00			
TAMC Administration & Contingency	6/29/18	$ -	$ -	$ 106,538.00	$ -	$ 106,538.00	$ -	$ -	$ -
Central Upper Peninsula Planning and Development	3 qtr 18	$ -	$ -	$ 88,641.00	$ 25,726.56	$ 62,914.44	$ -	$ -	$ -
East Michigan Council of Governments	SEPT	$ -	$ -	$ 328,607.00	$ 259,229.13	$ 69,377.87	$ -	$ -	$ -
Eastern Upper Peninsula Regional Planning & Devel.	4 qtr 18	$ -	$ -	$ 5,688.00	$ 5,688.00	$ -	$ -	$ -	$ -
Genesee Lapeer Shiawasse Region V Planning Com.	JULY	$ -	$ -	$ 124,909.00		$ 124,909.00	$ -	$ -	$ -
Grand Valley Metropolitan Council	4 qtr 18	$ -	$ -	$ 77,782.00	$ 69,733.25	$ 8,048.75	$ -	$ -	$ -
Kalamazoo Area Transportation Study	AUGUST	$ -	$ -	$ 50,402.00	$ 14,970.42	$ 35,431.58	$ -	$ -	$ -
Northeast Michigan Council of Governments	AUGUST	$ -	$ -	$ 33,506.00	$ 21,781.96	$ 11,724.04	$ -	$ -	$ -
Networks Northwest	SEPT	$ -	$ -	$ 184,513.00	$ 163,641.05	$ 20,871.95	$ -	$ -	$ -
Region 2 Planning Commission	3 qtr 18	$ -	$ -	$ 54,900.00	$ 2,328.00	$ 52,572.00	$ -	$ -	$ -
Southcentral Michigan Planning Commission	JULY	$ -	$ -	$ 93,456.00	$ 894.62	$ 92,561.38	$ -	$ -	$ -
Southeast Michigan Council of Governments	SEPT	$ -	$ -	$ 87,644.00	$ 45,757.96	$ 41,886.04	$ -	$ -	$ -
Southwest Michigan Planning Commission	4 qtr 18	$ -	$ -	$ 101,849.00	$ 67,138.17	$ 34,710.83	$ -	$ -	$ -
Tri-County Regional Planning Commission	4 qtr 18	$ -	$ -	$ 47,587.00	$ 6,962.44	$ 40,624.56	$ -	$ -	$ -
West Michigan Regional Planning Commission	SEPT	$ -	$ -	$ 241,511.00	$ 181,441.39	$ 60,069.61	$ -	$ -	$ -
West Michigan Shoreline Regional Development Com.	SEPT	$ -	$ -	$ 144,238.00	$ 89,092.30	$ 55,145.70	$ -	$ -	$ -
Western Upper Peninsula Regional Planning & Devel.	3 qtr 18	$ -	$ -	$ 63,229.00	$ 45,050.72	$ 18,178.28	$ -	$ -	$ -
Culvert Pilot Project Total		**$**	**$**	**$ 2,022,100.00**	**$ 1,158,747.97**	**$ 863,352.03**	**$ -**	**$ -**	**$ -**
Total Program		**$ 1,635,170.69**	**$ 83,941.64**	**$ 3,911,255.00**	**$ 2,626,983.33**	**$ 1,284,271.67**	**$ 1,864,960.00**	**$ 14,975.69**	**$ 1,849,984.31**
Appropriation		**$ 1,626,400.00**		**$ 3,876,400.00**		**32.84%**	**$ 1,876,400.00**		**99.20%**

2018 Michigan Local Agency Pavement Treatment Life Study

Peter Torola, PE, Research Engineer
Center for Technology & Training

Tim Colling, PhD, PE, Director
Center for Technology & Training

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Michigan Transportation Asset Management Council

Michigan Technological University
Civil and Environmental Engineering

Center for Technology & Training
Michigan Technological University
309 Dillman Hall
1400 Townsend Drive
Houghton, MI 49931

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EXECUTIVE SUMMARY

The Michigan Transportation Asset Management Council (TAMC) tasked the Center for Technology & Training (CTT) to determine updated statewide extended service life averages for pavement repair treatments used by Michigan's local agencies. The CTT, on behalf of the TAMC, previously conducted this study in 2014 and issued the report *Local Agency Capital Preventative Maintenance Extended Treatment Life Study* (Colling, Kiefer, & Farey, 2014). The 2014 study relied on the Extended Service Life (ESL) Calculator in the Roadsoft program, which is available to all Michigan local agencies at no cost to them. The current study used an updated version of the ESL Calculator. Thirty-six Michigan local agencies volunteered their data to the CTT for analysis, and twenty-nine of those agencies had data that met the criteria set forth in this study. This qualifying data set contained 6,236 road segments and 1,709.774 miles (2,751.615 kilometers) of roadway.

Large enough sample sizes were present to make statewide conclusions on five pavement treatments: chip seal, chip seal plus fog, thin overlay, crush and shape, and thick overlay (see Table 1 below). Michigan local agencies obtain a three-year increase in ESL when applying a fog seal in conjunction with a chip seal. Also notable is the 0.3-year decrease in ESL when applying a chip seal treatment to a pavement that has previously received a chip seal treatment.

Table 1: Summary of Weighted Average ESLs for Five Treatment Types

Treatment	Weighted Avg ESL
Heavy CPM	
Chip seal	**4.1**
Chip seal plus fog seal	**7.1**
Thin overlay	**6.9**
Rehabilitation	
Crush and shape	**11.3**
Thick overlay	**9.1**

The project team attempted to further analyze the data set by legal system, National Function Class, number of lanes, and region of the state. However, breaking the data into smaller subdivisions offered less opportunity to make any significant determinations. The factors that impact the effectiveness of repair treatments are highly variable when comparing multiple projects in aggregate, and trying to determine why segments of the data differed from others is difficult with the variability in pavements and practice. The statewide average ESL gain provides the best guidance for ESL gain because it includes samples that span a number of variables (e.g., agency policies, soil type, annual snowfall, underlying pavement structure, materials used, and construction methods) that are beyond the control of this study. The large data set available for analysis in Michigan demonstrates that the many types of treatments used by Michigan local agencies provide significant increases in extended service life.

1 INTRODUCTION

This study focuses on determining the extended service life (ESL) that can be gained for asphalt pavements by selecting and applying various preventive maintenance and repair treatments from data provided by Michigan local agencies. The Michigan Transportation Asset Management Council (TAMC) commissioned this study to collect ESL data for their own use as well as to show local agencies that they also have the tools and data necessary to complete their own ESL analyses as part of their annual business processes. The Center for Technology & Training (CTT), on behalf of the TAMC, conducted a similar study in 2014; in their final report *Local Agency Capital Preventative Maintenance Extended Treatment Life Study*, the CTT was only able to make definitive conclusions on chip seal treatments due to the limited data set (Colling, Kiefer, & Farrey, 2014). TAMC suggested repeating this study in 2018 due to the expected larger data set.

Analysis of data for the 2018 study exclusively uses distresses found in asphalt pavement since asphalt is the primary pavement type owned by Michigan local agencies. The study determined that local agencies in Michigan are actively using many types of repair treatments to maintain their asphalt pavements. However, chip seals are still the most widely used preventive maintenance treatment.

Modeling the extended service life resulting from repair treatments can effectively illustrate the value gained by applying repair treatments (Colling, Kiefer, & Farrey; 2014). Figure 1 shows a pavement that has been maintained in fair condition for nearly 22 years with three successive chip seal applications.

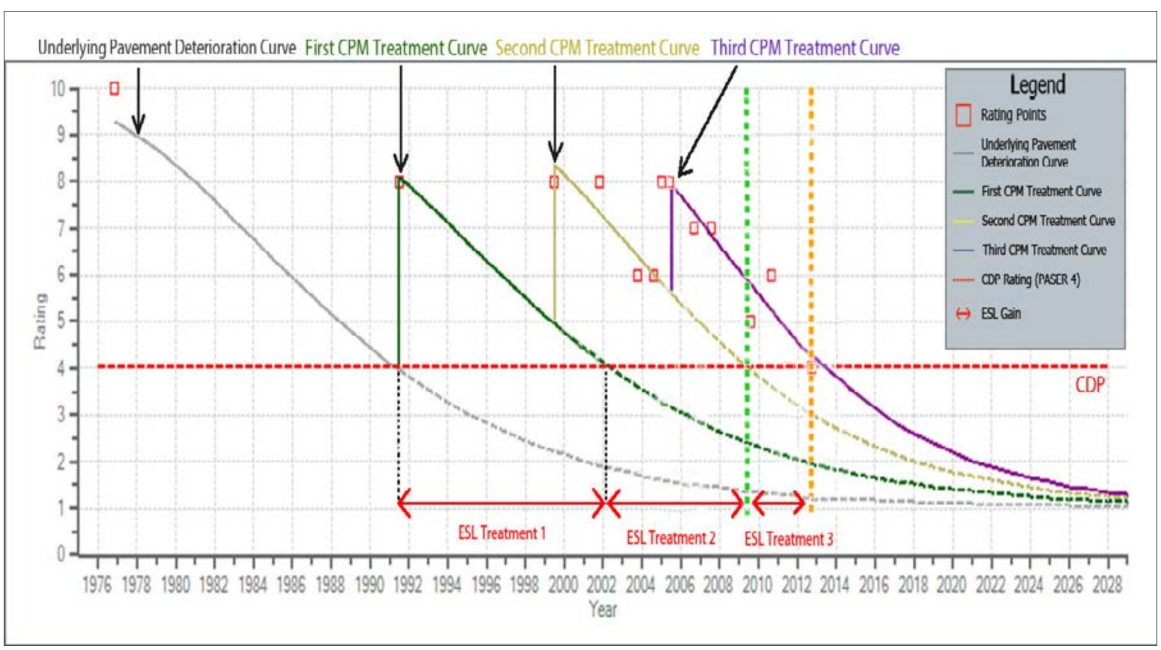

Figure 1: Example of multiple chip seal treatments. Note the diminishing ESL with successive treatment applications.

2 BACKGROUND

As a condition of Public Act 199 of 2007, Michigan road-owning agencies must collect road condition data annually on their Federal-aid-eligible road network. Additional condition data can also be collected on the non-Federal-aid-eligible portions of their road network at the discretion of the individual road-owning agency. Agencies rate road conditions using the Pavement Surface Evaluation and Rating (PASER) system, which is based on the severity, type, and extent of distresses present in the pavement. Since 2008, agencies have been collecting and submitting 100 percent of their Federal-aid-eligible road-network condition data on a two-year cycle with a minimum goal of 50-percent collection each year; between 2004 and 2007, agencies were collecting 100 percent of the network condition data each year. For the purpose of this study, agencies were not required to collect any data in addition to what was already collected for annual reporting.

Over 400 Michigan road-owning agencies currently use Roadsoft, a roadway asset management software program developed in the early 1990s at Michigan Technological University in cooperation with the Michigan Department of Transportation (MDOT) (see Roadsoft.org for more information). This software—made available to Michigan local agencies at no charge—provides tools for the data collection, storage, and analyses necessary to effectively apply asset management principles. The agencies that have been using Roadsoft typically store road condition and treatment data in Roadsoft that, in turn, could be used for ESL analyses.

In 2013, the TAMC funded the development of a Roadsoft tool—the Extended Service Life (ESL) Calculator—that enables local agencies to perform ESL analyses for their historical repair treatments. Roadsoft also has performance modeling functionality: it can generate a deterioration curve for the underlying pavement and for the same pavement subsequent to repair treatments (Figure 2). These modeling functions use a road segment's condition data (i.e., its PASER score) and treatment data (i.e., its maintenance history).

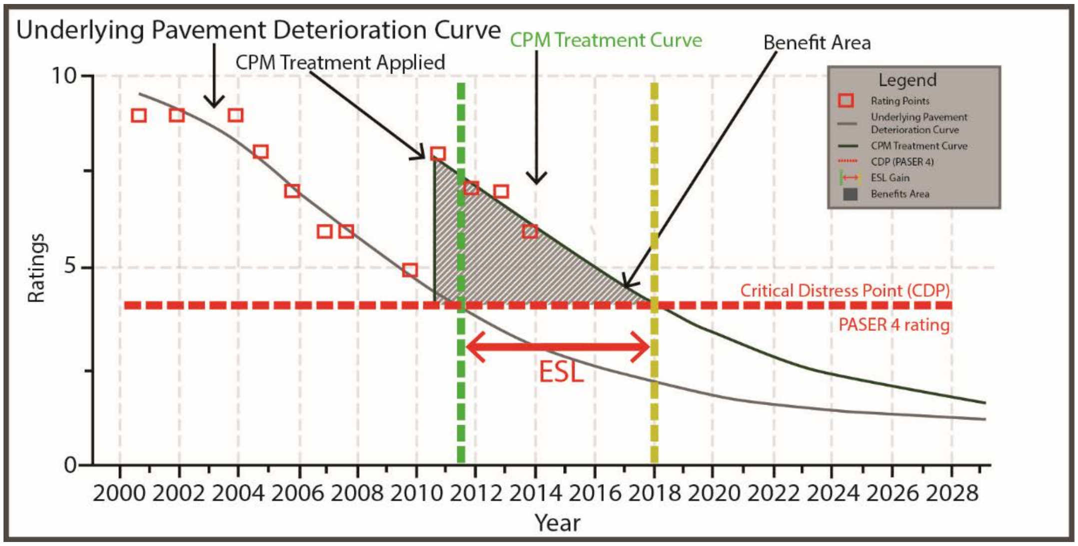

Figure 2: Example deterioration curve for the underlying pavement and subsequent repair treatment

2.1 Definition of Pavement Deterioration Technical Terms

The following terms refer to elements of the pavement deterioration curves [1]:

Underlying pavement deterioration curve: deterioration for the asphalt pavement prior to repair treatment

Repair treatment curve: deterioration for the asphalt pavement following the application of a repair treatment

Treatment applied: the time when the repair treatment was applied over the asphalt surface

Rating points: actual pavement condition ratings (using PASER) documented during TAMC data collection

Critical distress point (CDP): the PASER 4 line—when pavement deterioration changes from exhibiting age-related to structural distresses

ESL gain: the time in years gained by the application of a treatment

Benefits area: the area above the CDP that lies between the underlying pavement deterioration curve and the repair treatment curve.

2.2 Cost-effective Management of Assets

Asset management is the ongoing process of maintaining, upgrading, and operating physical assets in a cost-effective manner; it relies on continuous physical inventory and condition assessment.[2] Asset management principles give guidance for the cost-effective management of

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[1] For more information on the technical process that Roadsoft uses for pavement modeling, refer to Dong, McNinch, and Colling's "*Validation of the Use of PASER Condition Data and the Application of Growth Models for Predicting Local Agency Pavement Deterioration*" in Conference Proceedings Transportation Research Board, 8th National Conference on Asset Management, October 18, 2009.

[2] From Act 499, Public Acts of 2002, Michigan Department of Transportation. Available at: *www.mcgi.state.mi.us/mitrp/document.aspx?id=348*

pavements. In other words, the premise of asset management is to “keep good roads maintained in good condition.” The primary way of doing this is by applying relatively-low-cost repair treatments to extend pavement life, thereby delaying the need for costly rehabilitation and reconstruction.

Cost-effectiveness is a prime factor that road agencies use when selecting treatments because they generally need to maximize the use of limited agency funds. Determining the cost-effectiveness of repair treatments requires an agency to be cognizant of two factors: the treatment’s cost per-lane-mile and the amount of ESL that the treatment provides. Local agencies are usually very aware of the cost of repair treatments; however, the value of repair treatments in terms of ESL is seldom known beyond theoretical studies.

An accurate analysis of the ESL afforded by each repair treatment based on local data allows agencies to do two things: set a data-driven policy for applying specific treatments and provide a quantitative means for assessing the viability of treatment locations.

2.3 Asphalt Pavement Deterioration

Age-related distresses result from exposure to the environment over time. The primary environmental factors driving age-related distresses are water (which enters the pavement structure and weakens it), ultra-violet light, and atmosphere (which causes degradation of the asphalt binder and subsequent hardening). Asphalt binder is the “glue” that holds together the aggregates in an asphalt pavement. As the asphalt binder hardens, it becomes less flexible and is subject to cracking from tensile forces that develop during low-temperature events when the pavement contracts. Cracking allows the intrusion of water into the underlying pavement structural layers. Excess water makes the aggregate base and sub-base layers less rigid, which results in a larger magnitude displacement of the pavement layers at a given load. Distressed asphalt is then subject to increased vertical displacement of the pavement due to traffic loads, causing increased cracking and structural damage to the asphalt layer. Examples of age-related distresses include transverse cracking, longitudinal joint cracking, and block cracking (Figure 3). These cracks are “non-working” cracks: the pavement on each side has the ability to transfer load from one side of the crack to the other so the pavement on each side moves in unison as a load passes over.

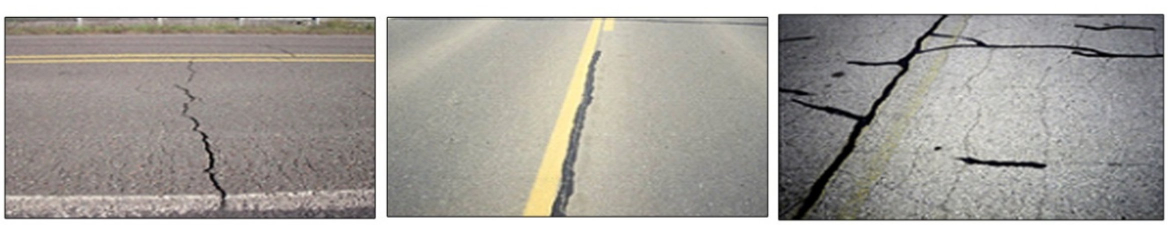

Figure 3: Age-related distresses

Structural distresses can occur at any time in the life of a pavement. These distresses typically result from traffic loading. Traffic loads in excess of the pavement's design load can speed the occurrence of structural distress. Examples of structural distresses include rutting, cracking in the wheel path, and alligator (fatigue) cracking (Figure 4). Structural-distress-related cracks are "working" cracks: the pavement on each side of a working crack moves independently as a load passes over. Capital preventive maintenance treatments are not structural in nature and, therefore, have a limited ability to span and maintain continuity across a working crack.

Rutting Cracking in the Wheel Path Alligator Cracking

Figure 4: Structural distresses

2.4 Capital Preventive Maintenance

Capital preventive maintenance (CPM) treatments typically address age-related pavement distresses prior to the presence of structural distresses. These treatments retard or offset age-related distresses. The TAMC classifies CPM treatments as either light or heavy. Common light CPM treatments include crack seal and fog seal, whereas common heavy CPM treatments include chip seal, slurry seal, cape seal, microsurface, and thin asphalt overlays. Other more specialized or proprietary CPM treatments exist.

2.4.1 Crack Seal (Light)

Description: A crack seal is a localized treatment method for cracks less than 0.75 inches (1.91 centimeters) wide. It is a sealant that fills a crack, which has been cleaned of debris by using a saw or router to create a clean reservoir. Crack seal is effective for approximately two years and has a lower per lane mile cost, making it a cost-effective solution in terms of per-year cost of extending service life.

Purpose: Crack seal prevents water and/or incompressible material from entering the pavement structure. Intrusion of water and/or incompressible material can weaken a pavement's base and inhibit the pavement from expanding and contracting freely.[3] Traffic loads can cause more damage to these weakened pavements

2.4.2 Cape Seal (heavy)

Description: A cape seal is a chip seal followed by a microsurface cover.

[3] From *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

Purpose: Cape seal treatments maximize the positive aspects of both chip seal and microsurface treatments by applying them together. The microsurface provides a dimensionally-stable layer that bridges defects, such as minor rutting, and provides a smoother travelling surface.[4] The chip seal provides a flexible membrane that disperses stress from cracks or defects in the underlying pavement; this protects the microsurface from early reflective cracking and provides additional waterproofing in the event of a crack in the microsurface.

2.4.3 Chip Seal or Seal Coat (Heavy)

Description: A chip seal—also known as seal coat—is an emulsion bond coat followed by an aggregate cover. A double chip seal is two consecutive layers of chip seal (asphalt bond coat and aggregate cover). Chip seal cures using a thermal-break process, which takes two to eight hours depending on climate conditions. Rapid-setting asphalt emulsions are available and commonly used. Chip seal lasts approximately five years. In some applications, chip seal can be combined with fog seal (see Fog Seal, below).

Purpose: Chip seal treatment protects pavement from environmental deterioration. A chip seal creates a waterproof membrane that prevents hardening and/or oxidation of the pavement and prevents water intrusion into the pavement structure, thereby helping an asphalt pavement to retain its flexibility and resistance to cracking.[5] Chip seal can also provide low-severity crack sealing and restore surface friction.

2.4.4 FOG Seal (Light)

Description: Fog seal is a diluted asphalt emulsion without a cover aggregate. Fog seal is applied to a pavement using an asphalt distributor. Fog seal lasts approximately two years. While fog seal itself is considered a light CPM treatment, it can be combined with chip seal for a heavy CPM treatment. Many Michigan local agencies apply fog seal directly over new chip seal as a standard practice on heavily traveled roads since the fog seal treatment provides waterproofing for the chip seal's stone chips and guarantees sufficient asphalt cement to retain the stone chips.

Purpose: Fog seal treatment seals and enriches the asphalt pavement surface, seals minor cracks, prevents raveling, and provides shoulder delineation.[6] While fog seal has been used on both low- and high-volume roads to prevent raveling and create delineation between travel lanes and shoulders, its use on high-volume roads is restricted due its reduction of pavement friction.

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[4] From Central Federal Lands Highway website, http://www.cflhd.gov/programs/techDevelopment/pavement/context-roadway-surfacing/documents/context5-append-a1.pdf

[5] From: *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

[6] From *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

2.4.5 Microsurface (Heavy)

Description: Microsurface uses a modified liquid asphalt, small stones, water, and portland cement—much like slurry seal—that are cured in a chemically-controlled process. Consequently, it is sometimes incorrectly referred to as a polymer-modified slurry seal. Microsurface lasts approximately seven years.

Purpose: Microsurface restores the transverse cross-section of a pavement profile.[7] It is used for rut filling, surfacing for roads with moderate- to heavy-volume traffic, increasing skid resistance, and reducing water intrusion into the pavement structure. Generally, microsurface is applied as a surfacing at less than 0.5 inches (1.27 centimeters), which adds no strength to the pavement structure but simply seals it from environmental deterioration agents.

2.4.6 Slurry Seal (Heavy)

Description: Slurry seal is a mixture of fine aggregate, asphalt emulsion, water, and mineral filler (often portland cement) that uses a thermal-break process for curing. Thermal-break curing requires heat from the sun and pavement, and can take two to eight hours depending on the heat and humidity. Slurry seal lasts approximately four years.

Purpose: Slurry seal treatment seals the asphalt surface, slows surface raveling, seals minor cracks, and improves surface friction. Slurry seal effectively remedies pavements prone to excessive oxidation and hardening of the existing surface. However, it is minimally effective if the underlying pavement contains extensive cracks.[8]

2.4.7 Thin Overlay (Heavy)

Description: Thin hot-mix-asphalt (HMA) overlays are blends of aggregate (different gradations possible) and asphalt cement often modified with polymer. Three gradation types of thin overlay are dense-graded, open-graded friction courses, and gap-graded. Typically, thin overlay range in thickness from 0.75 to 1.5 inches (1.91 to 3.81 centimeters).

Purpose: Thin overlays provide functional (non-structural) improvement as well as enhance smoothness, friction, and/or profile of asphalt pavements. However, they add little or no additional load-carrying capacity. Thin overlays are effective in all climatic conditions and on all types of roadways; they are particularly suitable for high-volume roads in urban areas where longer life and relatively low-noise surfaces are desired.[9]

2.5 Rehabilitation

Road requiring rehabilitation typically exhibit structural distresses like alligator cracking and rutting. Rutting is evidence of underlying structural failure and must be treated with a

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[7] From *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

[8] From *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

[9] From *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

rehabilitation option like crush and shape. In some cases, structural failure may call for reconstruction instead of rehabilitation.

2.5.1 Cold in-Place

Description: Cold in-place (CIP)—also known as CIP recycling—is a rehabilitation technique that requires pulverizing the existing asphalt, milling it, mixing it with new binder and materials, laying the new mixture as a base layer, and applying an overlay or surface treatment. It works well on moderate- to high-volume roadways. CIP maximizes use of existing materials and is a quick rehabilitation process.[10]

Purpose: CIP treats surface distresses that can reach up to 4 inches (10.2 centimeters) into the pavement structure.[11]

2.5.2 Crush and Shape

Description: Crush and shape is pulverization of a pavement and its base, followed by adding new gavel (optional), re-profiling the pavement, and placing a new wearing surface (such as an HMA overlay or chip seal). When crush and shape is used on urban roads, curb-and-gutter work is necessary. Crush and shape generally lasts 14 years.

Purpose: This treatment corrects severe structural distresses on rural roads. Additional gravel and an HMA overlay boost the pavement's structural capacity.

2.5.3 Hot in-place

Description: Hot in-place (HIP)—also known as HIP recycling—is a rehabilitation technique that incorporates surface recycling, remixing, and repaving. The existing asphalt is softened and then mixed with new asphalt; this softened and mixed asphalt is then laid over the remaining pavement structure and overlaid with HMA. HIP is a quick rehabilitation process but is sensitive to cooler temperatures and precipitation.[12]

Purpose: HIP treats distresses in a pavement's surface layer (typically those distresses in the top 2 inches, or 5.1 centimeters). It also corrects functional distresses like surface cracking, raveling, and friction loss.[13]

2.5.4 Hot-mix-asphalt Wedge

Description: Hot-mix-asphalt (HMA) wedge is a narrow 2- to 6-foot-wide (0.6- to 1.8-meter wide) wedge placed along the entire outside edge of a lane; the entire lane—including the section with the wedge—often receives an HMA or chip seal overlay to provide a new riding surface. This repair is often used as a stop-gap treatment in replace of a more expensive

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[10] From *Identifying Best Practices in Pavement Design, Materials, Construction, and Maintenance in Wet-Freeze Climates Similar to Michigan*, You, Z., Gilbertson, C., Van Dam, T., 2017: Michigan Department of Transportation.

[11] From *Identifying Best Practices in Pavement Design, Materials, Construction, and Maintenance in Wet-Freeze Climates Similar to Michigan*, You, Z., Gilbertson, C., Van Dam, T., 2017: Michigan Department of Transportation

[12] From *Identifying Best Practices in Pavement Design, Materials, Construction, and Maintenance in Wet-Freeze Climates Similar to Michigan*, You, Z., Gilbertson, C., Van Dam, T., 2017: Michigan Department of Transportation

[13] From *Identifying Best Practices in Pavement Design, Materials, Construction, and Maintenance in Wet-Freeze Climates Similar to Michigan*, You, Z., Gilbertson, C., Van Dam, T., 2017: Michigan Department of Transportation

repair that may not be fiscally possible. HMA wedge lasts approximately four years or longer for overlaid wedges.

***Purpose*:** HMA wedge corrects edge damage. It adds strength to severely settled areas of the pavement.

2.5.5 Thick Overlay

***Description*:** Thick overlay is a layer of new asphalt (liquid and stones) placed on an existing pavement. The overlay is over 1.5 inches (3.81 centimeters). Thick overlay lasts approximately five to ten years. It can be combined with mill treatment, which is the removal of the pavement surface via milling.

***Purpose*:** This treatment creates a new wearing surface for traffic and seals the pavement from water, debris, and sunlight. Depending on the overlay thickness, this treatment can add significant structural strength. A mill and overlay removes severe damage, preventing reflected structural problems, and omits the need for curb-and-gutter work.

2.6 Reconstruction

***Description*:** Pavement reconstruction involves complete removal of the old pavement and base followed by the construction of an entirely new road. Reconstruction lasts approximately 15 years. Comparatively, it is the most expensive treatment option and most disruptive to daily traffic. During its service life, a reconstructed pavement will likely require one or more CPM or rehabilitation treatments.

***Purpose*:** Reconstruction is appropriate when more cost-effective treatment options have been exhausted or when a road requires significant changes to its geometry, base, or underlying utilities.

3 GOAL OF THIS STUDY

ESL can be gained by applying the appropriate repair treatment on a pavement deteriorating from distress. The goal of this study is to determine the average ESL gain broken down by the category of treatment for the various treatments used by Michigan local agencies from the data set provided. The data will also be analyzed for any other similarities that can be associated with variations in the data set.

4 METHODS

This study employed an updated version of the ESL Calculator to select candidate roadway segments and evaluate whether they met the study selection criteria; the study also relied on Roadsoft's performance modeling functionality, including the deterioration curves that it can generate (see Figure 1).

Measuring the ESL created by a given treatment can help determine the benefit of repair treatments. ESL is the additional time in years that the pavement is above the CDP—or the additional time in years before the pavement experiences structural distresses (PASER 4 or below)—due to the repair treatment (Figure 5). This method evaluates the additional time before a pavement needs expensive treatments like rehabilitation or reconstruction. The ESL benefit directly affects the cost of roadway maintenance since it creates a tangible extension in pavement life.

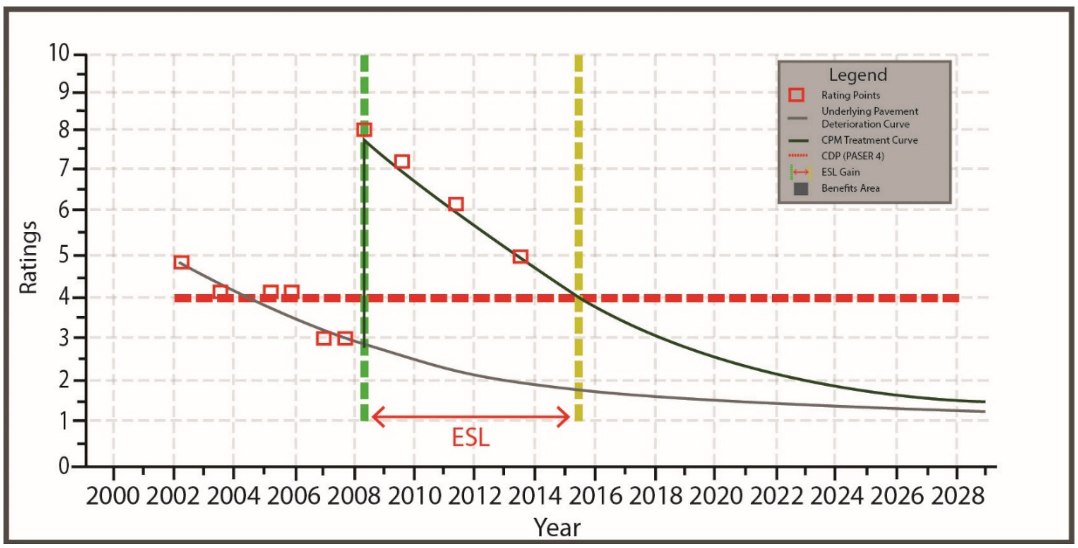

Figure 5: Example segment showing ESL with a positive improvement (gain) resulting from repair treatment and a decrease in pavement condition over time. In this instance, the underlying pavement deterioration curve crosses the CDP (PASER 4 line) prior to the pavement receiving a repair treatment.

4.1 Development of Data Set

The Center for Technology & Training (CTT) requested that Michigan local agencies submit their pavement condition and treatment data for this study. Because participation was voluntary, marketing was necessary to generate interest. Approximately 1,100 Michigan local agencies in the CTT database were contacted to request agency participation in the study. Advertisements for participation in the study were also circulated at conferences and training where local agency participation was expected.

The study did not require local agencies to perform excessive or in-depth data collection in order to illustrate how ESL analyses can be integrated into a local agency business process.

Local agencies only needed to provide basic data that they were already collecting as part of the annual TAMC collection effort. Local agencies exported data sets from Roadsoft—which most Michigan road-owning agencies already use to collect, analyze, and store their pavement management data—and sent them to the CTT via e-mail or FTP site uploads. Received data sets were verified for completeness, and catalogued by date and by submitting agency.

4.2 Selection Criteria of Qualifying Data for Analysis

Stringent criteria for selecting repair treatments minimizes modeling effects that would potentially bias results of this study. Restrictive selection criteria ensure that the study results are reliable and reflects the actual benefit provided by the repair treatment. Two sets of selection criteria were used to generate the final data set: road network selection criteria and repair treatment selection criteria.

Each agency's data set was evaluated in Roadsoft using the network builder and filter tools to isolate the portions of the road network meeting selection criteria. Road network selection criteria used in this study were as follows:

- Pavement segments must be asphalt designated with an asphalt standard surface sub-type or designated as a similarly-constructed asphalt pavement with a surface sub-type name defined by the local agency. Asphalt pavements comprise the majority of paved roadway miles owned by local agencies in Michigan. Since the expected life of an asphalt pavement without preventive maintenance treatments is approximately 15 years, asphalt segments in Michigan will fall into various PASER categories. Limiting asphalt pavements to standard surface sub-types provides uniformity in the construction of the asphalt pavement whereas other asphalt pavements may be built to varying standards that affect both their service life and extended service life consequent to repair treatments.
- Segments must be Federal-aid-eligible. Because the Federal-aid network is eligible for Federal funding, it likely receives the majority of repair treatment activity, thus providing the greatest number of candidate segments for the study.

Qualifying road segments were assessed for repair treatments meeting selection criteria. An updated version of Roadsoft's ESL Calculator was used to identify and evaluate repair treatments on the qualifying network that met repair treatment selection criteria. The updated ESL Calculator, which will be released to Roadsoft users in the near future, was used to produce modified ESL calculations to simplify data analysis for this study. The repair treatment selection criteria used in this study were as follows:

- The repair treatments must be the first treatment in its TAMC treatment classification system (i.e., light CPM, heavy CPM, rehabilitation, or reconstruction) applied over the original asphalt pavement or over a heavier or lighter treatment than the one being analyzed; treatments applied over similar treatment classes were separated into a data set that analyzed diminishing returns. When a treatment of the same classification is applied multiple times over a surface without increasing the pavement's structure with an HMA overlay (e.g., a chip seal applied over a chip seal), the subsequent treatment yields diminishing returns, or reduced effectiveness at extending the pavement's life or realizing ESL consequent to treatment.

- Qualifying road segments must have a minimum of three PASER scores prior to and three following the treatment of interest. This can reasonably define the underlying pavement deterioration curve (determined from three scores or more prior to treatment) as well as the repair treatment curve (determined from three scores or more following the treatment).
- The treatment could not be a crack seal or a crack fill. The PASER system is not sensitive enough to show rating changes due to applying a crack seal treatment, which makes measuring benefit of this short-life treatment difficult. Nonetheless, crack seal is low cost, and research suggests it provides an additional ESL of one to three years when applied correctly.
- The data must be from the year 2000 or subsequent years. Data collected prior to the year 2000 is less reliable due to differences in construction, specifications, and materials, as well as the limited availability of PASER training for Michigan local agencies.

4.3 Application of Pavement Modeling to Qualifying Data Set

Roadsoft's pavement modeling functionality generated a unique performance model for each road segment in the qualifying data set. The performance model—comprised of an underlying pavement deterioration curve and a repair treatment curve—for each segment depended upon the segment's PASER scores and maintenance history data. Each of the unique performance models were reviewed individually, by hand, in order to verify that the results were reasonable and that the models fit the data well.

The ESL for each road segment was calculated as the time in years between curve and/or treatment application intersects with the CDP (PASER 4 line). In many cases, road segments received repair treatments prior to the pavement reaching its CDP (PASER 4 line); in these instances, the ESL was calculated as the time between the underlying pavement deterioration curve's theoretical intersection with the CDP and the repair deterioration curve's intersection with the CDP (see Figure 2). In cases where the pavement reached its CDP before receiving a repair treatment, the ESL was the time between the application of the repair treatment and the repair treatment curve's intersection with the CDP (Figure 5).

When there was an actual PASER 4 score following the repair treatment rather than just the modeled intersection, that rating point was considered as the end point for ESL measurement regardless of where the repair treatment curve intersected the CDP (Figure 6). This was an additional conservative measure to eliminate modeling effects.

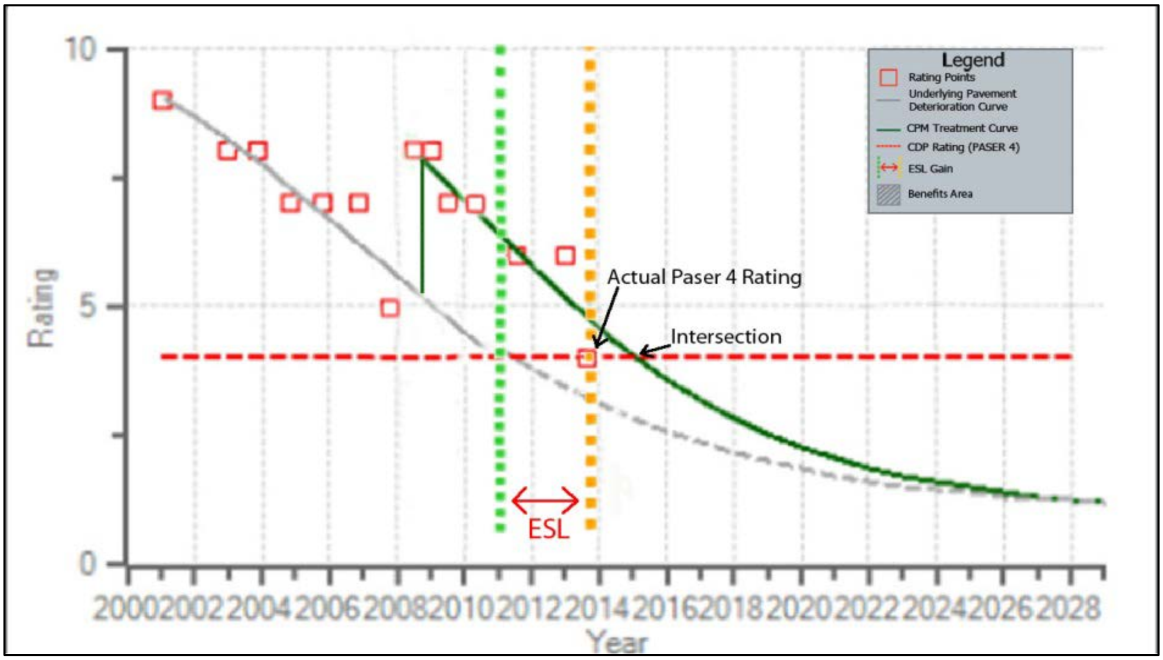

Figure 6: PASER 4 following repair treatment

Some repair treatment curves produced a negative ESL on paper when the curves intersected the CDP prior to the underlying pavement deterioration curve's intersection. It is assumed that a repair treatment will not negatively affect the life of the pavement but, in certain cases, may not provide an extended service life. Therefore, these performance models were classified as having an ESL equal to zero.

In some cases, the performance data indicated an ESL in excess of 15 years for heavy CPM treatments and 20 years for rehabilitation treatments. These ESLs are unexpected and outside the normal range of ESL for these treatment types. ESL was limited to a maximum of 15 years for heavy CPM treatments and a maximum of 20 years for rehabilitation treatments as a conservative measure to inhibit a few data points from skewing the entire data set (refer to the Discussion Topics section of this report for an explanation of limiting ESL for high performing segments and the sensitivity analysis of this decision).

Data was analyzed for each qualifying treatment category by agency, and then at a statewide level. ESL was assigned to each treated road segment meeting the selection criteria; these individual segment ESLs combined to create a weighted average using the length in miles of each segment as the weighting factor, which accounts for variation in segment lengths. Weighted average ESL was calculated for each treatment and each agency as well as an overall weighted average ESL for the state by treatment type. This data set was further segments by legal system classification (e.g., county primary, city major), National Functional Classification

(NFC), number of lanes, and by region in order to identify any common trends. The Cochran Formula was used to estimate sample sizes necessary to produce ESL results with a margin of error of 15% based on an estimate of the parent population. Required sample sizes ranged from 35 miles for relatively rare treatments like cape seal which have a small population size, to 43 miles for common treatments like chip seal that have a very large population size. The use of miles of treatment as a sample size estimator was considered to be conservative, since there are likely several separate observations per mile which tend to lower the required sample size.

5 RESULTS

Thirty-six agencies submitted data for consideration of use in this study. The analyzed data included 51,645 road segments, which consisted of 10,578.360 road miles (17,024.220 kilometers)—or 12% of Michigan's paved Federal-aid network)—that met the following criteria in Roadsoft:

- Act 51 equals true
- Sub Base equals Asphalt Standard (one agency used Asphalt)

Of the originally submitted data pool, 29 agencies' data met the selection criteria defined in the Methods section of this report. The application of the selection criteria resulted in 6,236 road segments—or 1,709.774 miles (2,751.615 kilometers) of road data—that had qualifying repair treatments. The seven agencies whose data did not meet selection criteria comprised a significant amount of data. Reasons for excluding their data included segment data pertained to pavements constructed and treated prior to 2000 (see maximum age selection criterion in the Methods section) and segment data pertained to pavements with successive repair treatments of the same TAMC classification (see discussion about diminishing returns in the Methods section).

The 29-agency data pool produced 14 discrete treatments that met the selection criteria for analysis. Table 2 summarizes these treatments. Six of the 14 treatments— cape seal, chip seal, chip seal plus fog, thin overlay, crush and shape, and thick overlay—has significantly large enough sample sizes to produce a sound statewide average ESL.

Only two agencies, in close proximity to each other, used cape seal; so this data is representative of local or regional level rather than at a state level. A larger number (10-25) of agencies used the other five treatments and covered a more diverse portion of the qualifying road network statewide, so these data are representative at a statewide level.

Table 2: Summary of Extended Service Life by Treatment Type

Treatment	Agencies	Segment Count	Total Miles	Weighted Avg ESL
Heavy CPM				
Cape seal	2	**260**	**35.042**	6.0
Chip seal	**21**	**2372**	**784.858**	**4.1**
Chip seal plus fog seal	**10**	**514**	**195.890**	**7.1**
Microsurface	3	129	26.679	2.3
Slurry seal	1	20	1.999	3.7
Thin overlay	**20**	**666**	**161.899**	**6.9**
Rehabilitation				
Cold-in-place (CIP) plus overlay	1	7	2.092	6.1
Crush and Shape	**10**	**453**	**142.537**	**11.3**
Hot-in-place (HIP)	1	12	1.349	11.1
HIP plus overlay	2	15	2.095	7.3
HMA wedge plus chip seal	1	13	5.060	4.6
HMA wedge plus overlay	4	58	25.003	5.7
Thick overlay	**25**	**1584**	**301.760**	**9.1**
Reconstruction				
Reconstruction	6	133	23.511	9.9
Total	**29**	**6236**	**1709.774**	

5.1 Cape Seal

Cape seal treatments meeting the selection criteria totaled 35.042 miles (56.394 kilometers) (Figure 7). Cape seal is a relatively new treatment in Michigan, and records from the TAMC Investment Reporting Tool (IRT) indicate that only 46 miles of this treatment were applied in 2017 on local agency owned roads. In the data set two agencies indicated use of cape seal; their total segment count was 260. The weighted average ESL for this regional data set was 6.0 years. It is interesting to note that only 0.58 miles (0.93 kilometers) of cape seal resulted in a zero ESL improvement. This may be due to the limited amount of agencies in the data set, or to the increased care these agencies use in selecting locations for cape seals.

Figure 7 shows a fairly-uniform bell-curve shaped distribution with the most frequently observe cohort of seven years of ESL. This is indicative of a normally distributed data set. The box plot of this data is depicted in Figure 8 which illustrates the distribution of data points. The non-weighted average is represented as a blue line and the median is represented as a black line in Figure 8 The left side of Figure 8's black skeletal box plot represents the first quartile, the center is the median, and the right side is the third quartile. Black tick marks represent the minimum and maximum on the left and right side, respectively. The black dashed-line area illustrates the 95% confidence interval containing the median; the blue dashed-line area is the 95% confidence interval containing the unweighted average. The blue dashed-line area centers over the unweighted average. Since these data points are not weighted by miles, the box plot and mean plot will show a skew due to segment length.

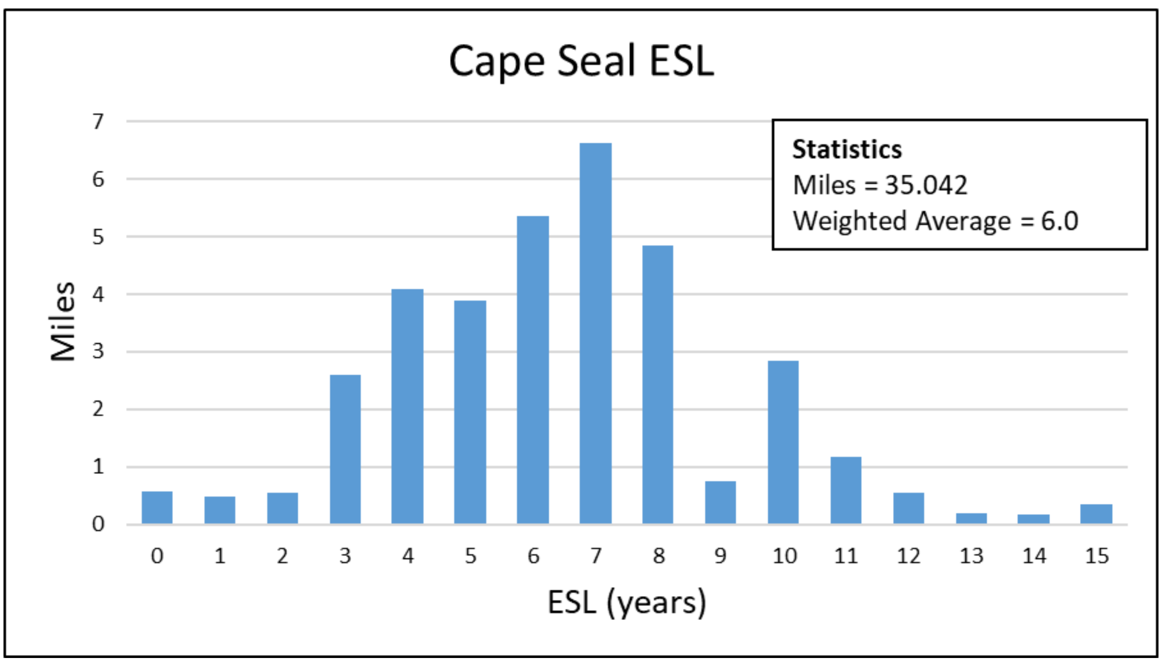

Figure 7: Cape seal qualifying miles distribution by ESL

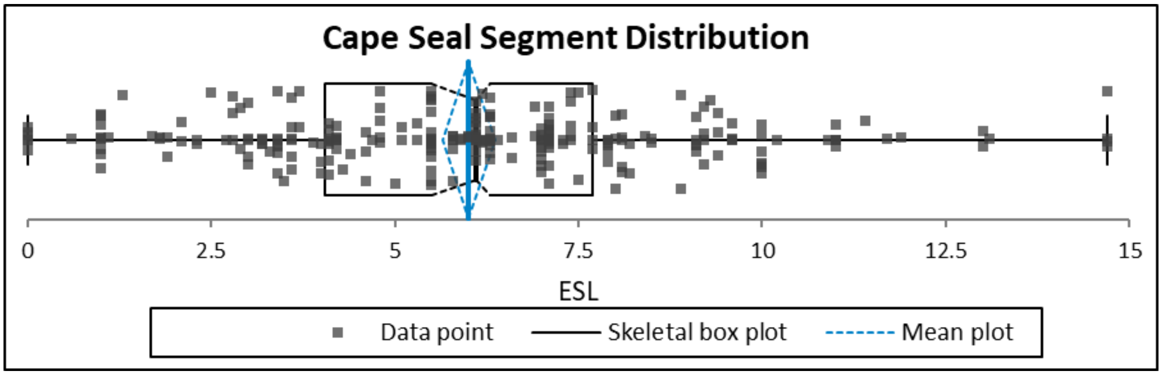

Figure 8: Cape seal non-weighted average ESL segment distribution

5.2 Chip Seal

Chip seal was the most prevalent repair treatment in the data set. Chip seal prevalence is likely due to chip seals' long-time use in the United States and, thus, the good understanding that agencies have of chip seal treatment as well as the ability local agencies have to apply it with minimal equipment, work forces, and cost. Treatments such as slurry seal, microsurface, and cape seal are newer and offer attractive aesthetic properties but cost considerably more, and most studies have shown that they have similar performance lives to chip seal.

As Table 2 indicates, chip seals meeting the selection criteria totaled 784.858 miles (1,263.107 kilometers). Twenty-one agencies indicated use of chip seal; their total segment count was 2,372. A fairly-uniform trend in a histogram plot of increasing ESL values indicates that ESL gains of over 9 years are uncommon and ESL gains between 0 and 7 years are frequent (Figure 9). This data set did have 114.59 miles (184.415 kilometers) with an ESL gain of zero, which is depicted as 364 segments in Figure 10. The weighted average ESL for the data set was 4.1 years and is the same weighted average that was found in the 2014 ESL study (Colling, Keifer, & Farrey; 2014) using different data sets and different local agencies. This weighted average accounts for instances where no ESL was gained by the treatment.

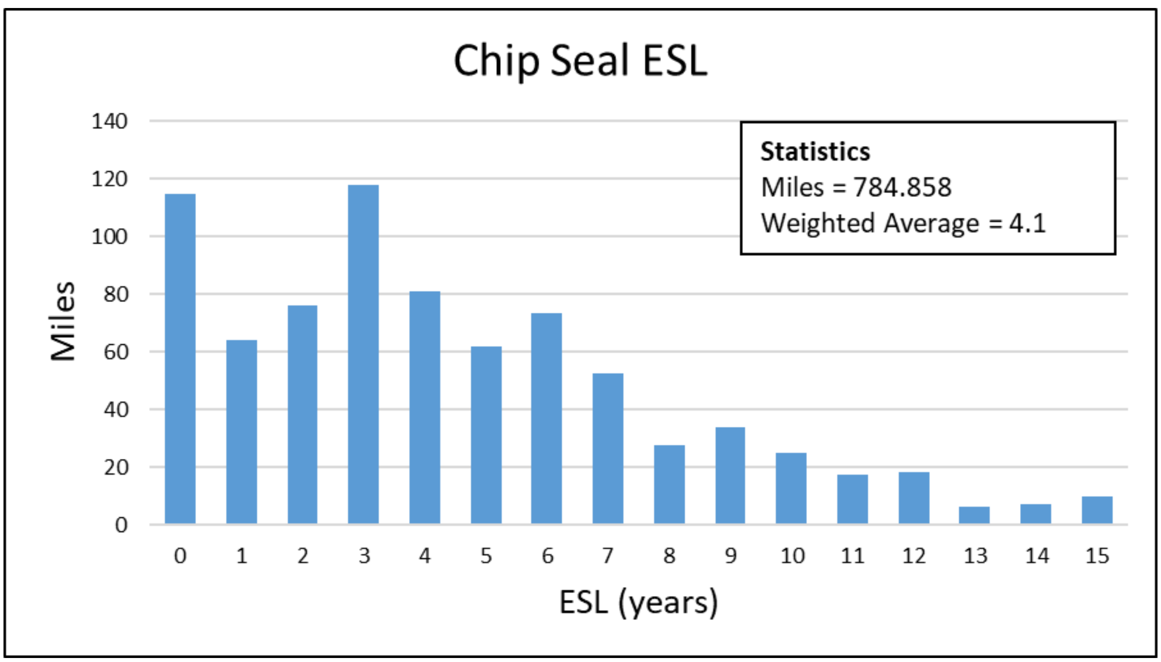

Figure 9: Chip seal qualifying miles distribution by ESL

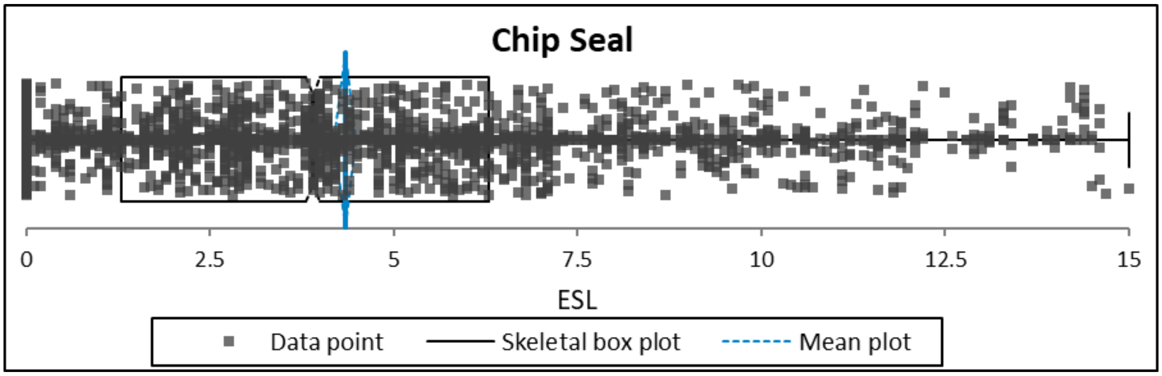

Figure 10: Chip seal non-weighted average ESL segment distribution

5.3 Chip Seal *Plus* Fog Seal

This combination treatment was specifically identified in the data set and analyzed separately. Chip seal plus fog seal treatments that met the selection criteria totaled 195.890 miles (315.254 kilometers) (Figure 11). Ten agencies included this treatment as a distinct data set; with a total segment count of 514. Figure 11 shows a total of 44.769 miles (72.049 kilometers)of chip seal plus fog seal that have over 10 years of ESL, which is 22.8% of this data set. Another interesting find is that there is only 0.222 miles (0.357 kilometers) with zero ESL gain, which is significantly lower than standard chip seals. The weighted average ESL for the data set was 7.1 years. Of the six significant treatments, chip seal plus fog seal had the most change in ESL after adjusting for skew due to segment size; this can be shown when comparing the weight average of 7.1 years to the non-weighted average of 6.4 years. Figure 12 shows the non-weighted data points for chip seal plus fog seal treatment.

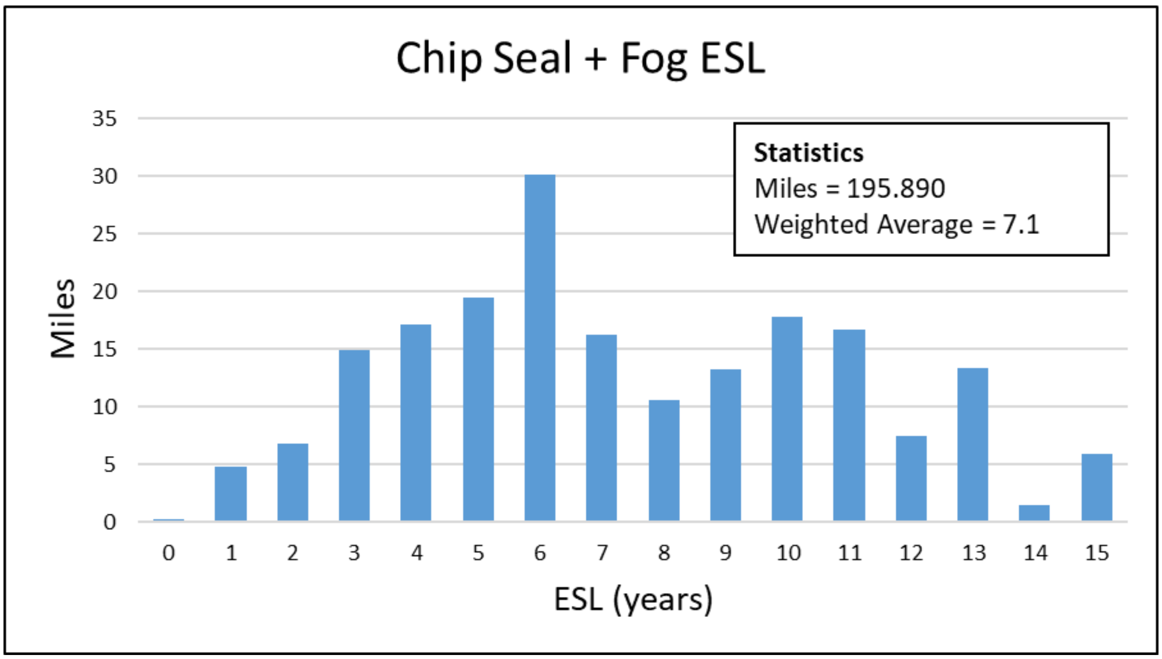

Figure 11: Chip seal plus fog seal qualifying miles distribution by ESL

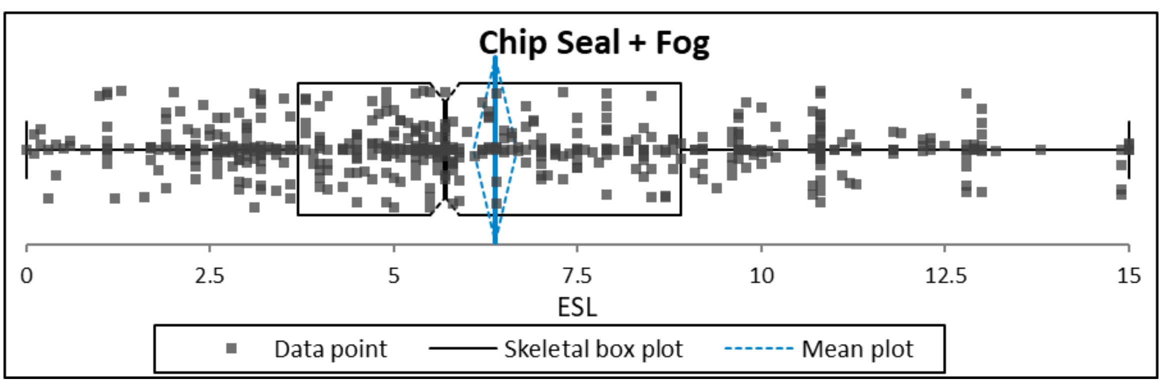

Figure 12: Chip seal plus fog seal non-weighted average ESL segment distribution

An interesting finding was the increased ESL for placing a fog seal on top of a chip seal. Twenty-one agencies used chip seal alone and had a weighted average ESL of 4.1 years. Ten agencies used chip seal plus fog seal and had a weighted average ESL of 7.1 years; nine of these agencies used both chip seal and chip seal plus fog seal. The nine agencies were analyzed separately to minimize uncontrollable factors influencing treatment life (Figure 13 and Table 3). Applying the Student's *t*-test analysis to the central tendency of the two treatments—chip seal and chip seal plus fog seal—used by these nine agencies revealed that their average ESL gains are statistically significant. This means that there are differences in the central tendency (average ESL) for both of these treatments that is not a result of the variability of the data. The non-weighted average ESL gain for chip seal plus fog seal was 1.7 while the weighted average ESL gain was 2.9 years.

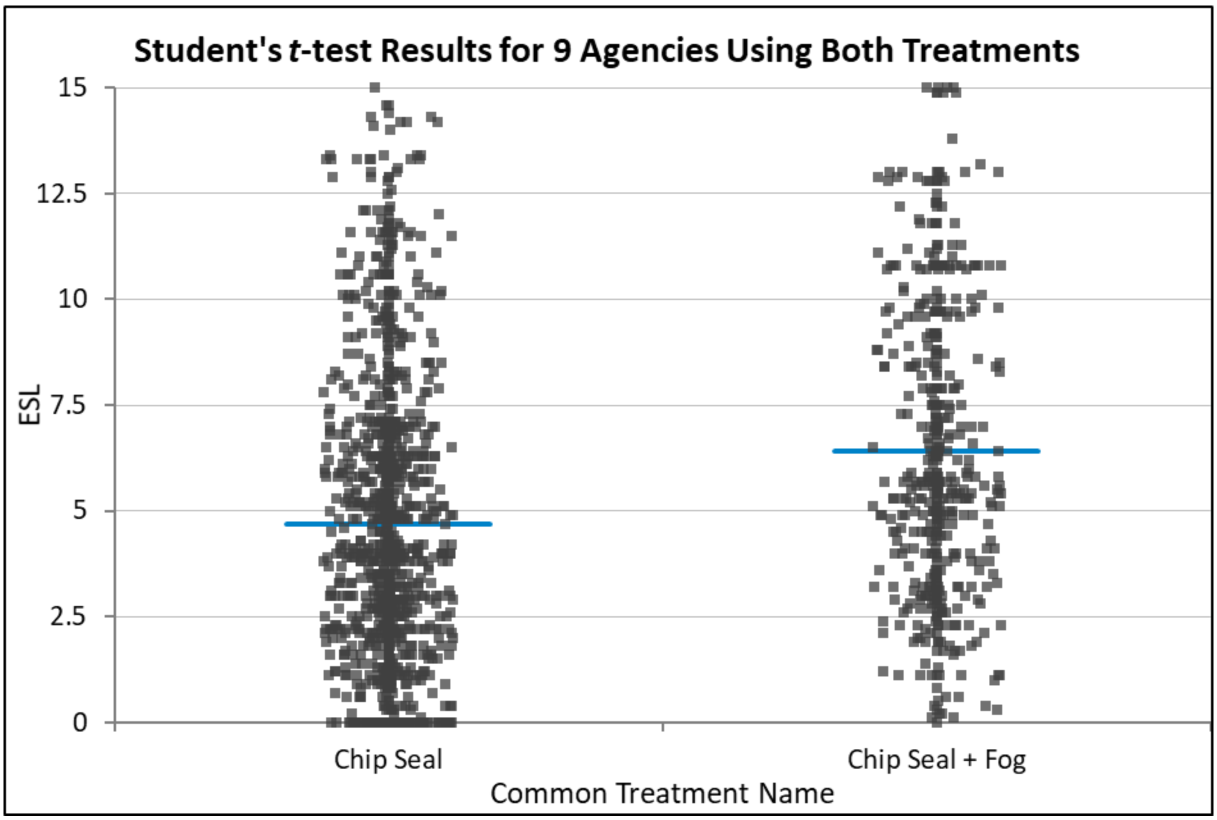

Figure 13: Chip seal vs. chip seal plus fog seal non-weighted average ESL segment distribution

Table 3: Nine Agencies that use Both Chip Seal and Chip Seal Plus Fog Seal

ESL by Common Treatment Name	n	Mean (not weighted)	Mean SE	SD
Chip seal	1265	4.68	0.091	3.24
Chip seal plus fog seal	509	6.40	0.151	3.41
Mean difference	1.72			
SE	0.173			
Student's *t* test				
Hypothesized difference	0		DF	1772[1]
t statistic	9.95		*p*-value	<0.0001

[1] Reject the null hypothesis in favor of the alternative hypothesis at the 10% significance level.

5.4 Microsurface

Microsurface treatment meeting the selection criteria totaled 26.679 miles (42.936 kilometers) (Figure 14). Three agencies indicated use of microsurface; their total segment count was 129. The weighted average ESL for the limited data set was 2.3 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive. Figure 15 shows the non-weighted average ESL median as 2.4 years and the mean as 2.9 years. The 2014 ESL study calculated a weighted average ESL of 5.4 years from a 7.9-mile (12.7-kilometer) data set (Colling, Kiefer, & Farrey; 2014). Whereas the 2014 study analyzed only one agency, this study analyzed three agencies' microsurface treatment segments. Both studies did not contain large enough sample sizes for microsurfacing to draw conclusions about the effectiveness of this treatment.

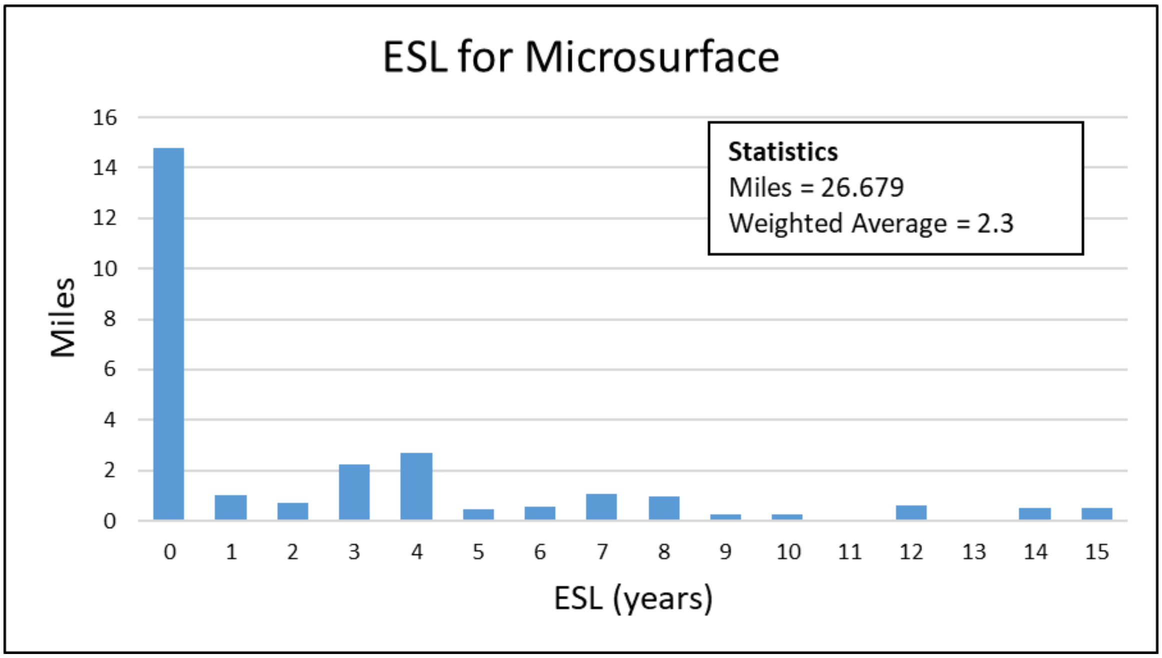

Figure 14: Microsurface qualifying miles distribution by ESL

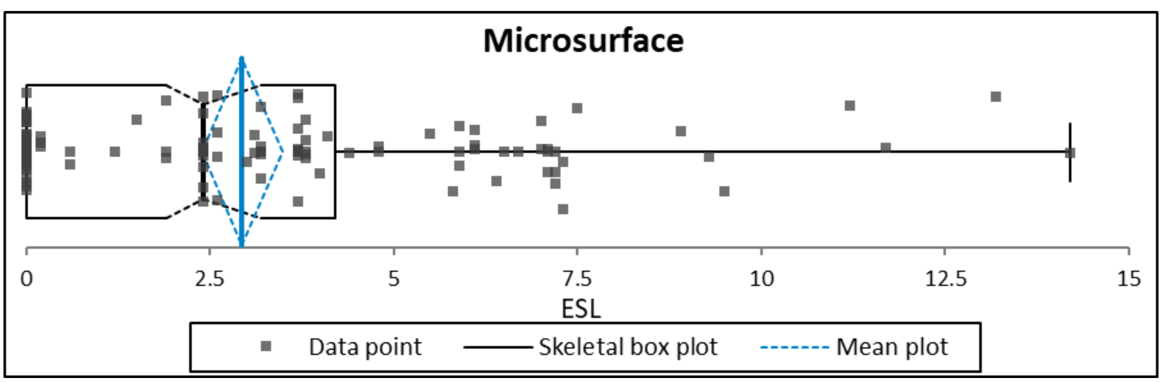

Figure 15: Microsurface non-weighted average ESL segment distribution

5.5 Slurry Seal

Slurry seal treatments meeting the selection criteria totaled 1.999 miles (3.217 kilometers) (Figure 16). One agency indicated use of slurry seal; their total segment count was 20. The weighted average ESL for the limited data set was 3.7 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 17).

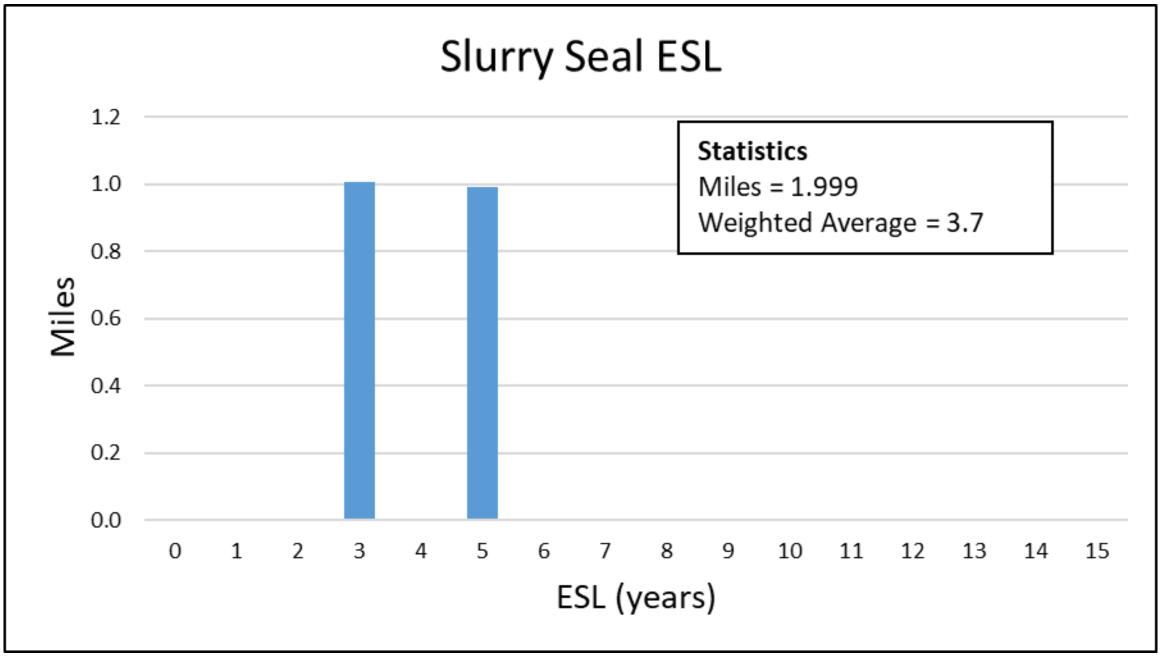

Figure 16: Slurry seal qualifying miles distribution by ESL

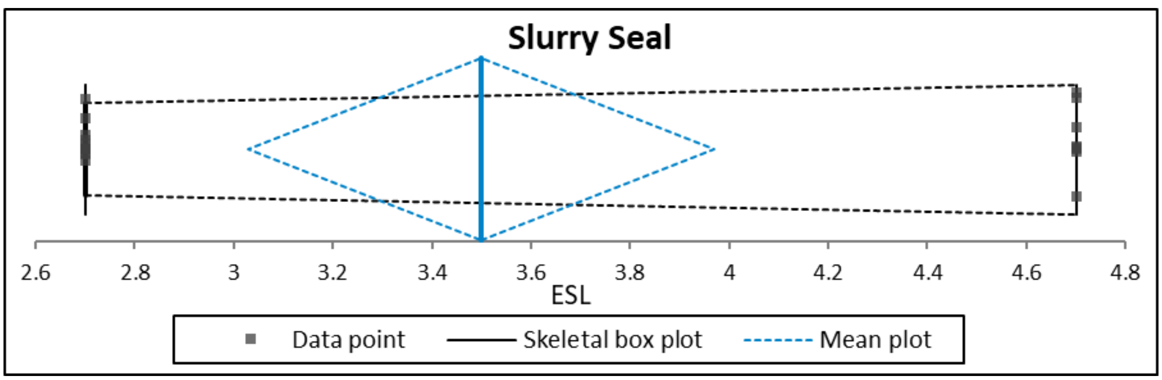

Figure 17: Slurry seal non-weighted average ESL segment distribution

5.6 Thin Overlay

Thin overlay treatments meeting the selection criteria totaled 161.899 miles (260.551 kilometers) (Figure 18). Twenty agencies indicated use of thin overlay; their total segment count was 666. The weighted average ESL for the data set was 6.9 years. There were 8.071 miles (12.989 kilometers)—or 21 segments—having more than 15 years of ESL (ESL ranging from 16 to 36 years) and a weighted average ESL of 18.7 years; these segments were excluded from Figure 19. There could be many reasons (e.g. agency policy, traffic volumes, and, underlying distresses, more careful selection criteria) why the chip seal plus fog achieved a higher ESL weighted average as compared to thin overlay treatments, which could only be identified with a more intensive study.

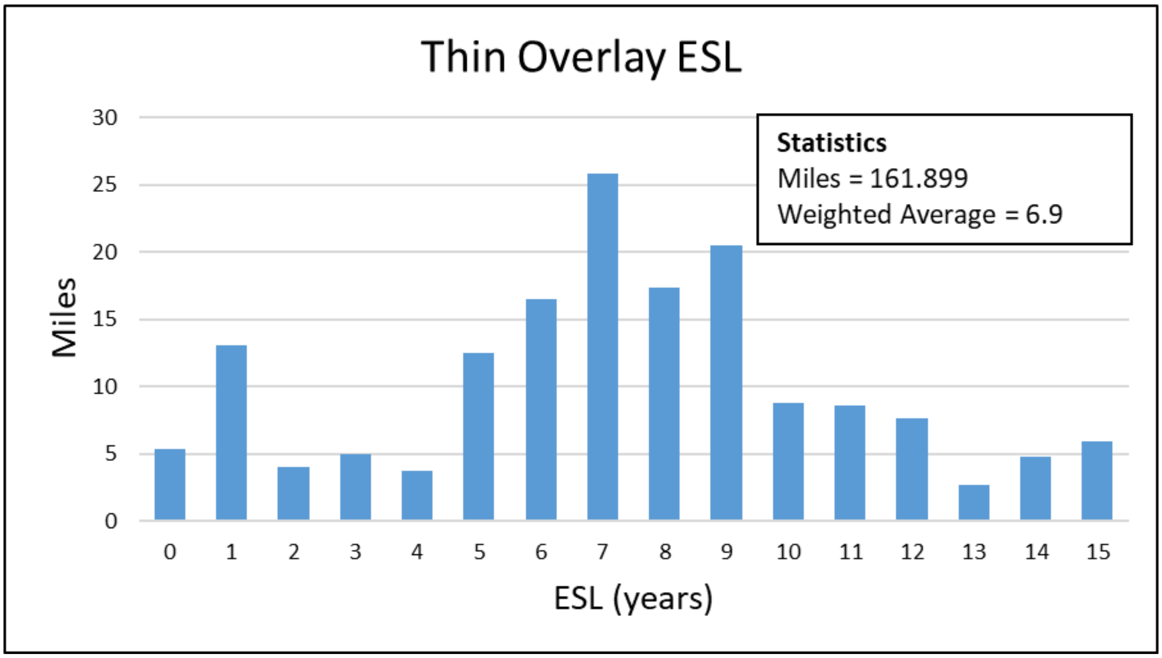

Figure 18: Thin overlay qualifying miles distribution by ESL

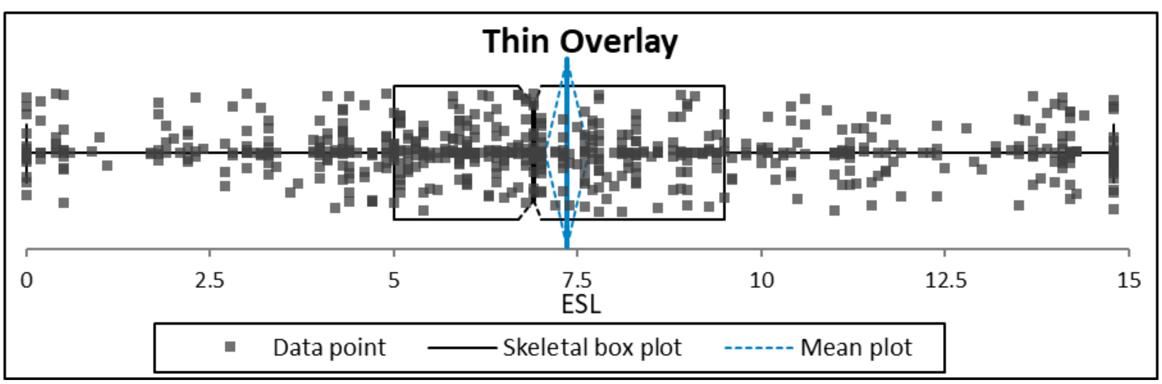

Figure 19: Thin overlay non-weighted average ESL segment distribution

5.7 Cold-in-Place *Plus* Overlay

Cold-in-place (CIP) plus overlay treatments meeting the selection criteria totaled 2.092 miles (3.367 kilometers) (Figure 20). One agency indicated use of CIP plus overlay; their total segment count was 7. The weighted average ESL for the limited data set was 6.1 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 21).

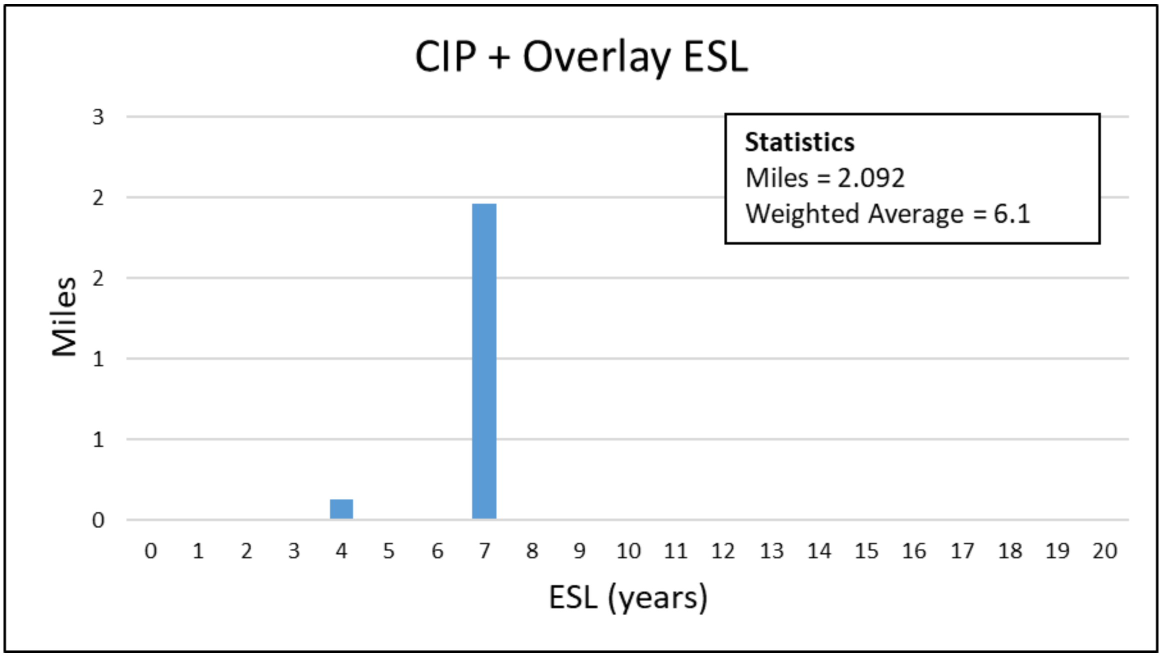

Figure 20: CIP plus overlay qualifying miles distribution by ESL

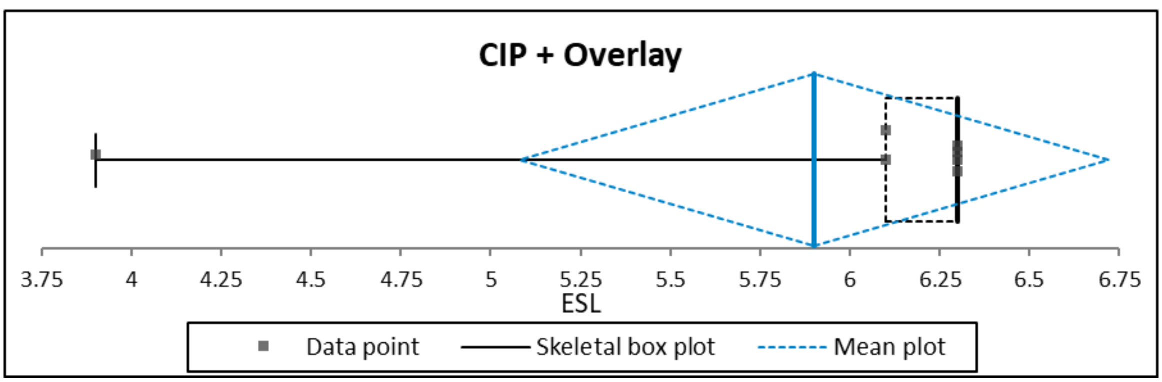

Figure 21: CIP plus overlay non-weighted average ESL segment distribution

5.8 Crush and Shape

Crush-and-shape treatments meeting the selection criteria totaled 142.537 miles (229.391 kilometers) (Figure 22). Ten agencies indicated use of crush and shape; their total segment count was 453. The weighted average ESL for the data set was 11.3 years (Figure 23).

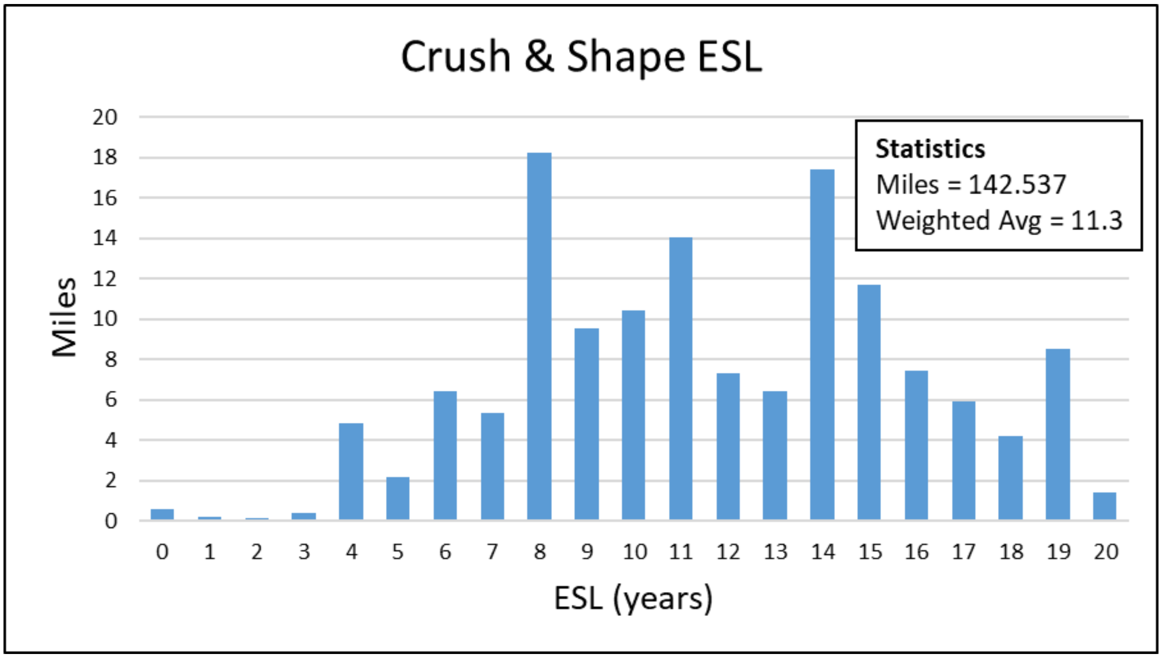

Figure 22: Crush and shape qualifying miles distribution by ESL

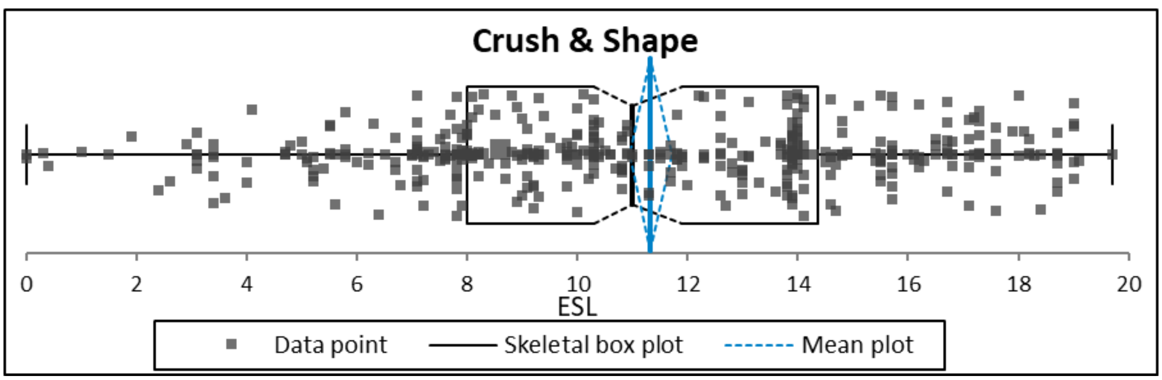

Figure 23: Crush and shape non-weighted average ESL segment distribution

5.9 Hot-in-Place

Hot-in-place (HIP) treatments meeting the selection criteria totaled 1.349 miles (2.171 kilometers) (Figure 24). One agency indicated use of HIP; their total segment count was 12. The weighted average ESL for the limited data set was 11.1 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 25).

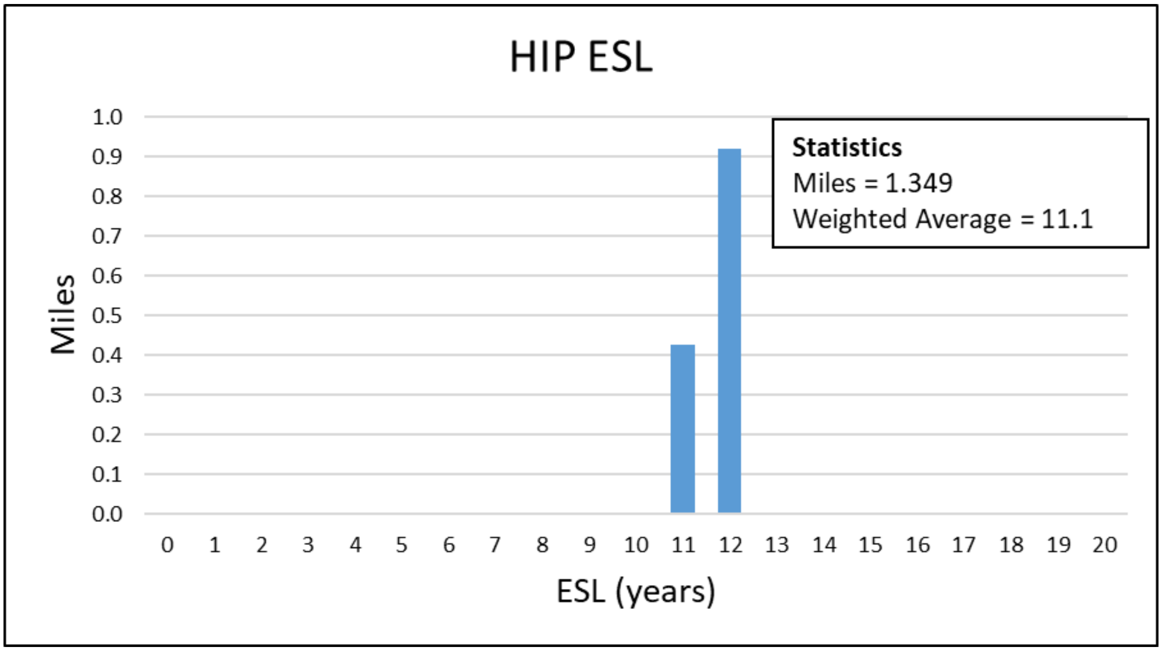

Figure 24: HIP qualifying miles distribution by ESL

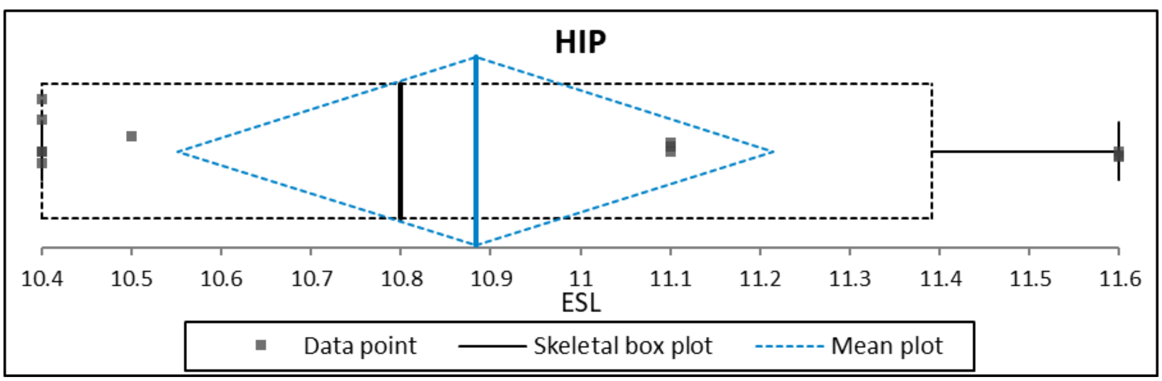

Figure 25: HIP non-weighted average ESL segment distribution

5.10 Hot-in-Place *Plus* Overlay

Hot-in-place (HIP) plus overlay treatments meeting the selection criteria totaled 2.095 miles (3.372 kilometers) (Figure 26). Two agencies indicated use of HIP plus overlay; their total segment count was 15. The weighted average ESL for the limited data set was 7.3 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 27).

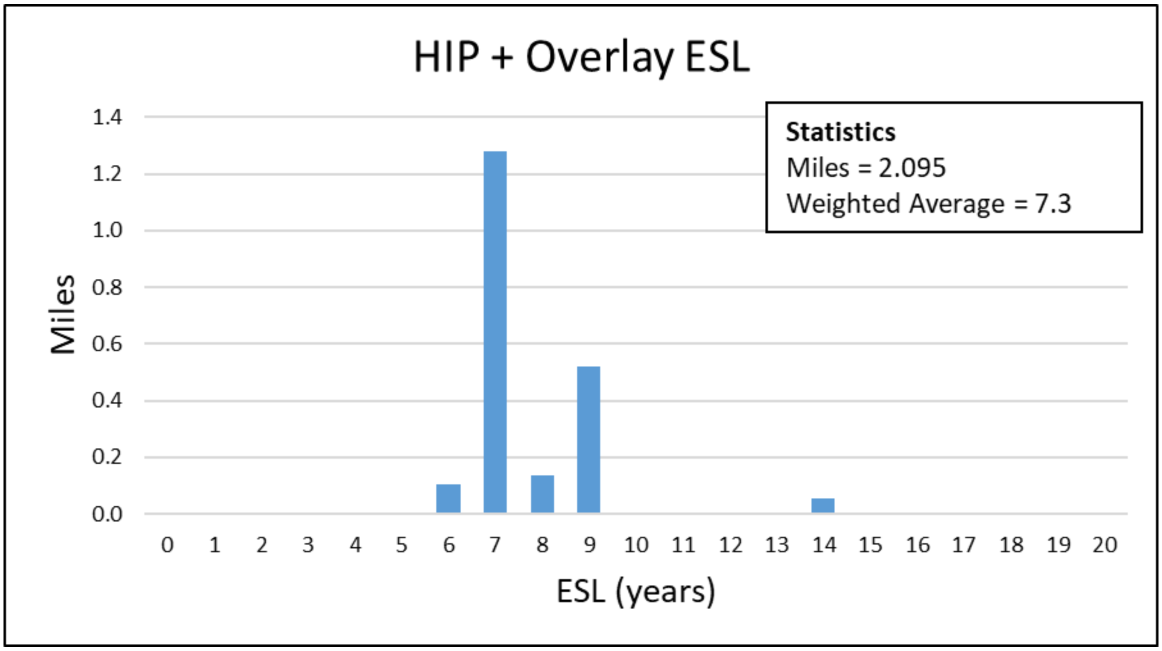

Figure 26: HIP plus overlay qualifying miles distribution by ESL

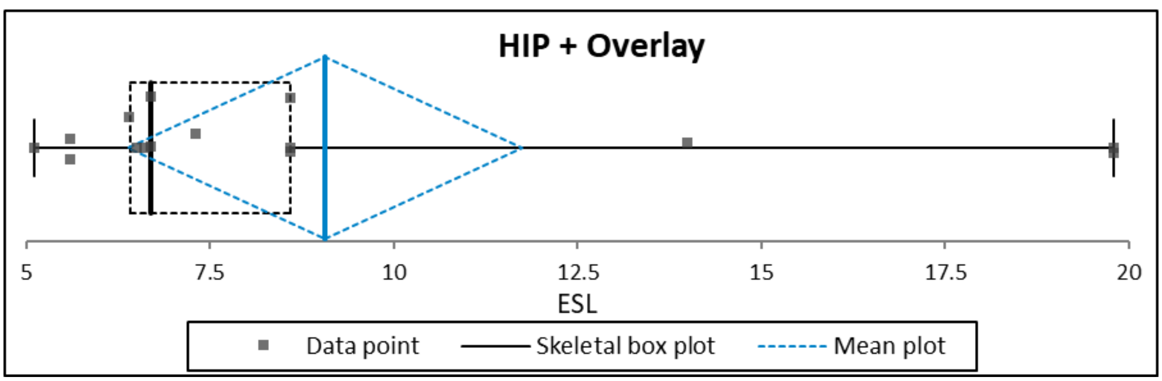

Figure 27: HIP plus overlay non-weighted average ESL segment distribution

5.11 Hot-mix-asphalt Wedge *Plus* Chip Seal

Hot-mix-asphalt (HMA) wedge plus chip seal treatments meeting the data selection criteria totaled 5.060 miles (8.143 kilometers) (Figure 28). One agency indicated use of HMA wedge plus chip seal; their total segment count was 13. The weighted average ESL for the limited data set was 4.6 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 29).

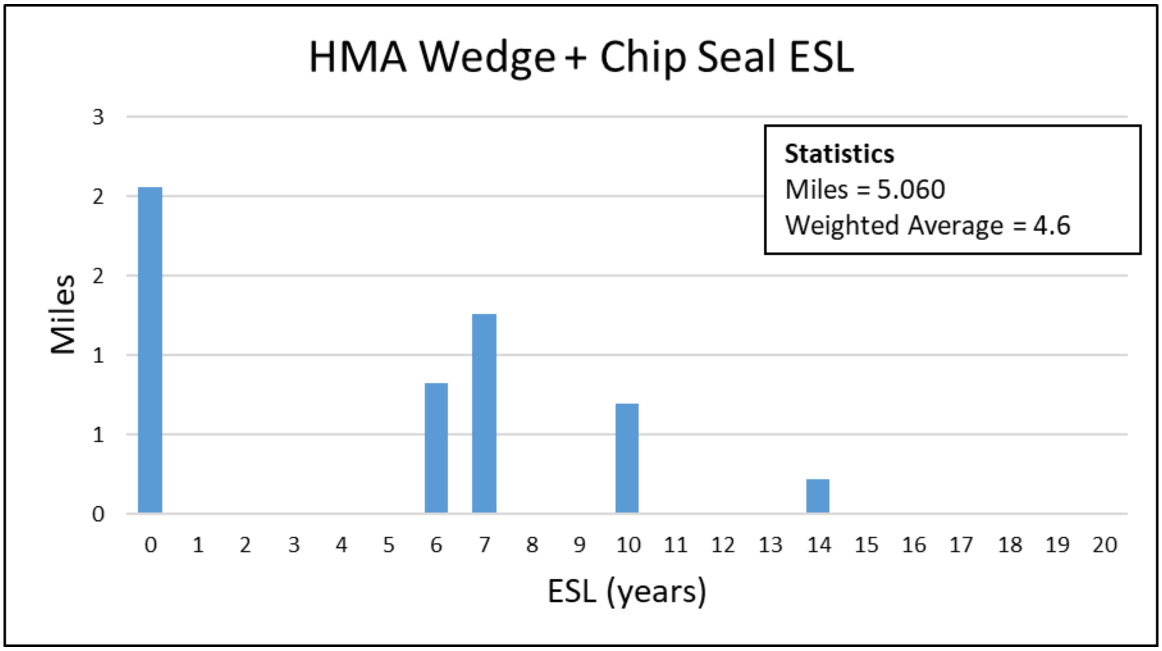

Figure 28: HMA wedge plus chip seal qualifying miles distribution by ESL

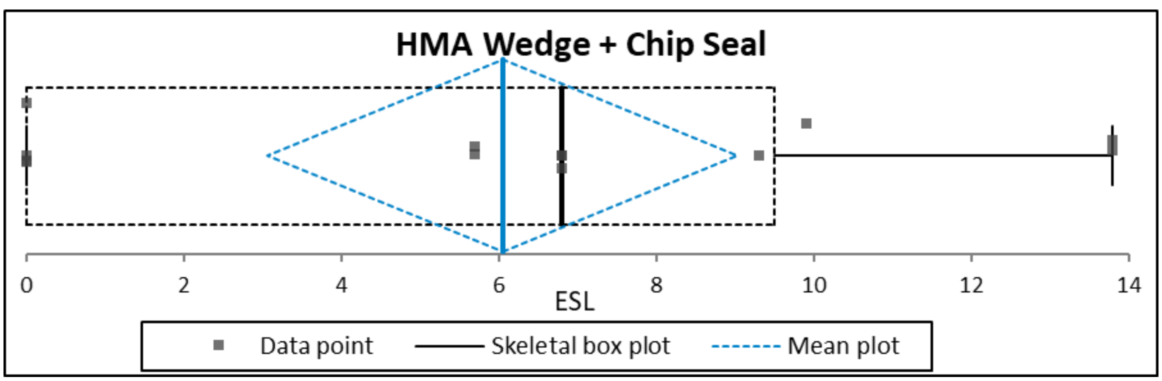

Figure 29: HMA wedge plus chip seal non-weighted average ESL segment distribution

5.12 Hot-mix-asphalt Wedge *Plus* Overlay

Hot-mix-asphalt (HMA) wedge plus overlay treatments meeting the data selection criteria totaled 25.003 miles (40.238 kilometers) (Figure 30). One agency indicated use of HMA wedge plus overlay; their total segment count was 58. The weighted average ESL for the limited data set was 5.7 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive. (Figure 31).

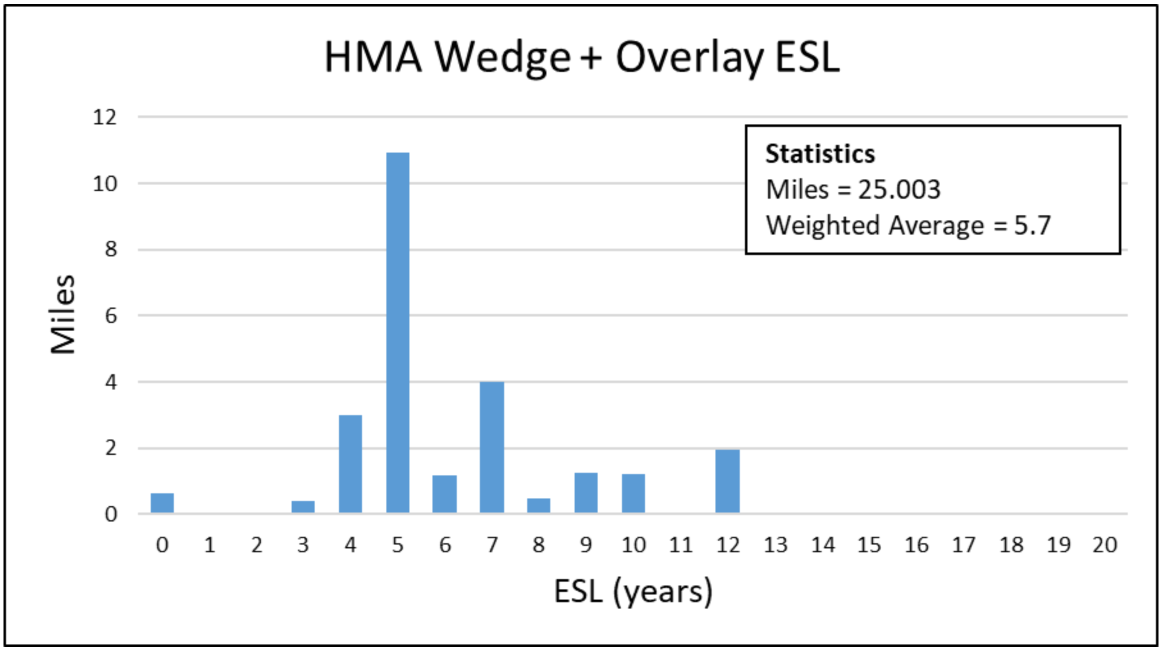

Figure 30: HMA wedge plus overlay qualifying miles distribution by ESL

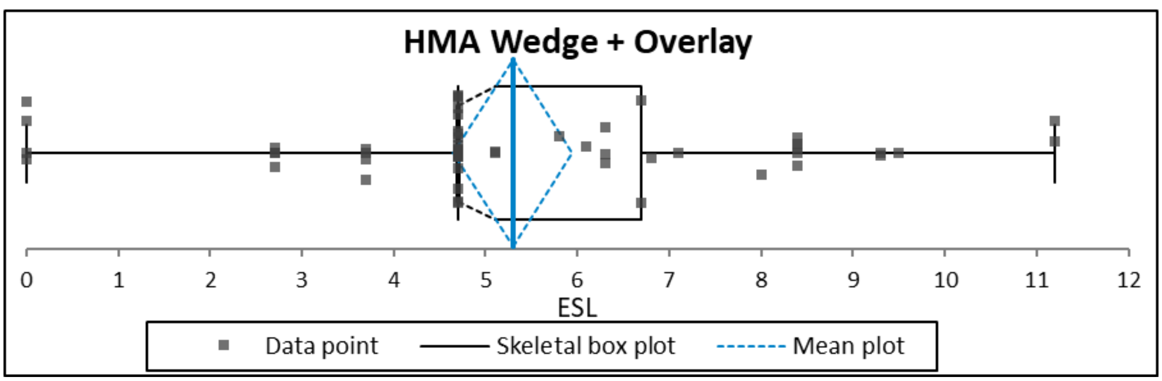

Figure 31: HMA wedge plus overlay non-weighted segment distribution

5.13 Thick Overlay

Thick overlay treatments meeting the data selection criteria totaled 301.760 miles (485.636 kilometers) (Figure 32). Twenty-five agencies indicated use of thick overlay; their total segment count was 1,584 (Figure 33). The weighted average ESL for the data set was 9.1 years. The thicknesses of the reported thick overlay treatments ranged from 1.75 to 5 inches (4.4 to 12.7 centimeters); a general trend showed an ESL gain as the thickness increased, which is what would be expected.

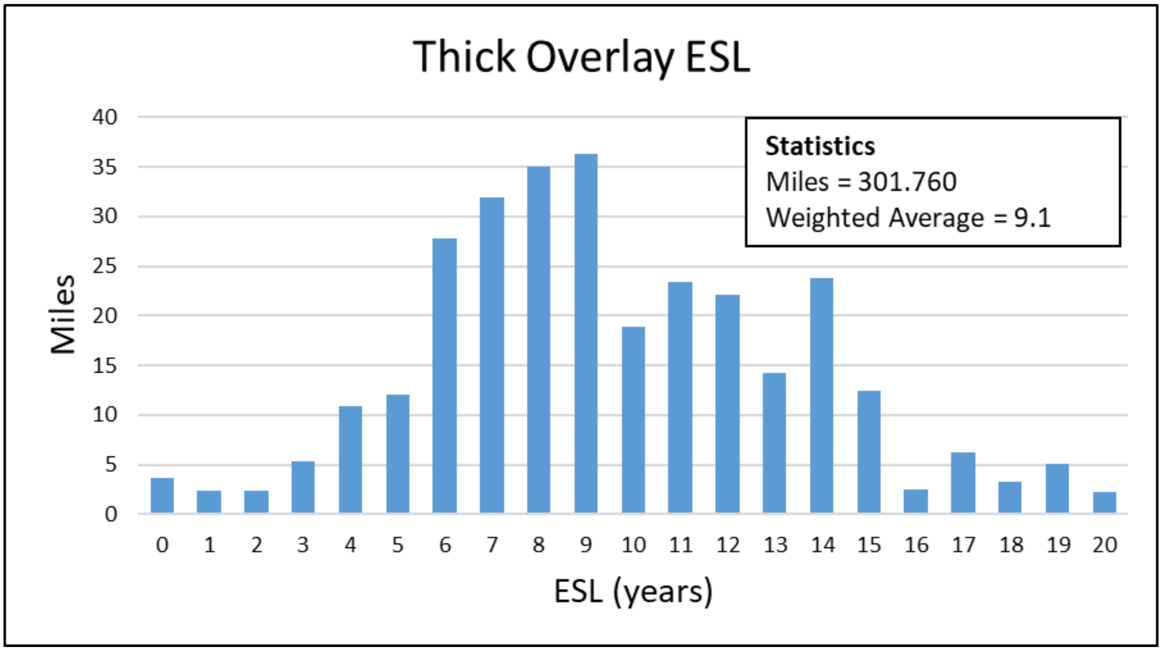

Figure 32: Thick overlay qualifying miles distribution by ESL

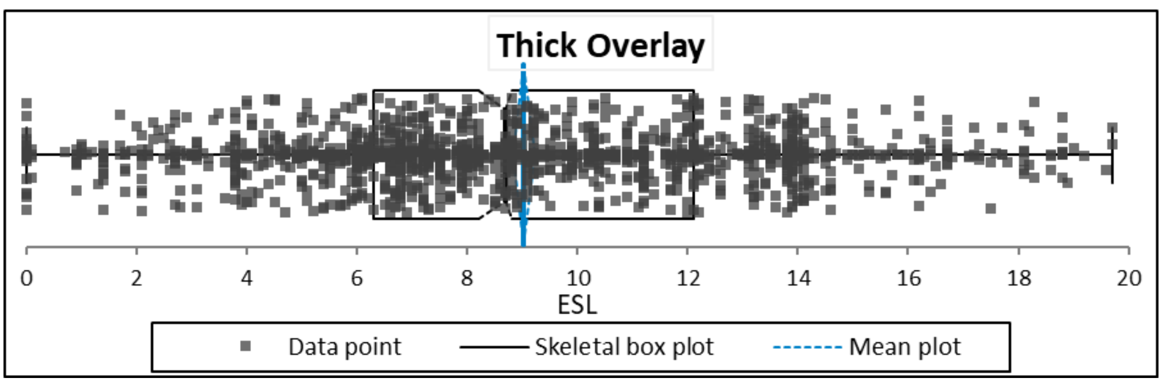

Figure 33: Thick overlay non-weighted average ESL segment distribution

5.14 Reconstruction

Reconstruction meeting the data selection criteria totaled 23.511 miles (37.837 kilometers) (Figure 34). Six agencies indicated use of reconstruction; their total segment count was 133. The HMA thickness layer of these reconstruction projects ranged from 1.5 to 3 inches (3.8 to 7.6 centimeters). This may help explain why the thicker HMA layers used in thick overlay treatments obtained a higher ESL value than the estimated service life of reconstruction. The estimated service life was used instead of extended service life because a reconstruction project creates a brand new pavement structure. The weighted average estimated service life for the limited data set was 9.9 years, however, this average has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 35). This data set included a large number of segments that were recently constructed, which limited the number of late age data points in this data group. As a result, the estimated service life calculated from this data is inconclusive.

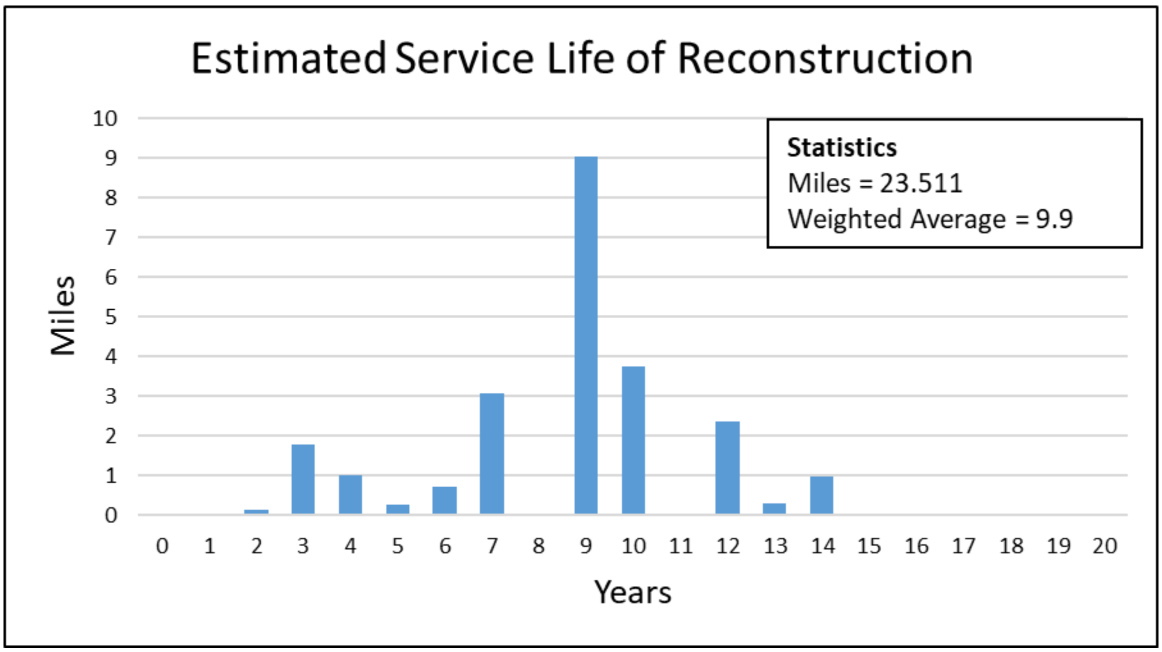

Figure 34: Reconstruction qualifying miles by estimated service life distribution

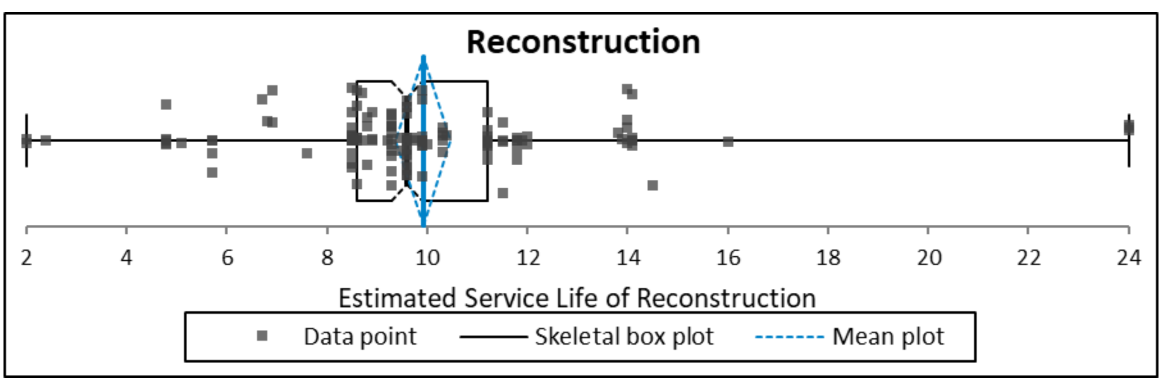

Figure 35: Reconstruction non-weighted average estimated service life segment distribution

5.15 Data Set Breakdowns for Analyses

Data sets were subdivided by different classification systems in order to analyze trends, identify and eliminate sampling biases, and compare and contrast the findings. Data sets were divided as follows:

5.15.1 By Legal System Classification

Examining the data based on the legal system classification aimed to facilitate analysis and to identify and eliminate sampling bias for differences in agencies' road classifications, which are maintained through agency-specific policies. The legal system classification breaks down the data set road miles (and segments) into county local, county primary, city major, city minor, and state trunkline. Federal-aid routes were isolated as a unique data set. In the Federal-aid-route dataset, (94.96%) were county primary. Table 4 summarizes mileage breakdown by legal classification and treatment class. There were too few miles (and segments) classified in the non-'county primary' categories to make determinations on differences for most of the treatment classes. The 1.444 miles (2.323 kilometers) marked as "State Trunkline" or "N/A" appeared to be mislabeled route(s).

Table 4: Mileage Breakdown by Legal Classification System and Treatment Class

Treatment Class	County Local	County Primary	City Major	City Minor	State Trunkline	N/A
Heavy CPM	4.824	1157.198	43.9	0.445	-	-
Rehabilitation	6.134	438.764	33.319	0.235	1.054	0.39
Reconstruction	-	15.241	8.27	-	-	-
Total	**10.958**	**1611.203**	**85.489**	**0.68**	**1.054**	**0.39**

5.15.2 By National Function Class

Examining the data based on national function class (NFC) aims to identify and eliminate sampling bias for differences in agencies' road classifications, which are maintained through agency-specific policies. The NFC breaks down the data set road miles (and segments) into major collector, minor arterial, minor collector, and principal arterial. Table 5 summarizes the mileage breakdown by NFC and treatment class. The 0.39 miles (0.628 kilometers) marked as "N/A" appeared to be mislabeled route(s).

Table 5: Mileage Breakdown by National Function Class and Treatment Class

Treatment Classification	Major Collector	Minor Arterial	Minor Collector	Principal Arterial	N/A
Heavy CPM	984.405	207.322	3.404	11.236	-
Rehabilitation	323.225	132.518	0.091	23.672	0.39
Reconstruction	11.732	10.709	-	1.07	-
Total	**1319.362**	**350.549**	**3.495**	**35.978**	**0.39**

When broken down by NFC, all of the treatment classes either showed no difference in ESL or had too few miles (and segments) to make determinations on differences for treatments with the exception of thick overlay treatment. For thick overlay treatment distributed by NFC, the classifications of major collector, minor arterial, and principal arterial had enough miles (and segments) to be considered statistically significant (Figure 36). The weighted average ESLs are 9.4 years for major collectors, 8.4 years for minor arterials, and 10.2 years for principal arterial. The principle arterial median data has a higher variability (Figure 36); therefore, this data set should be considered less reliable than major collector and minor arterial.

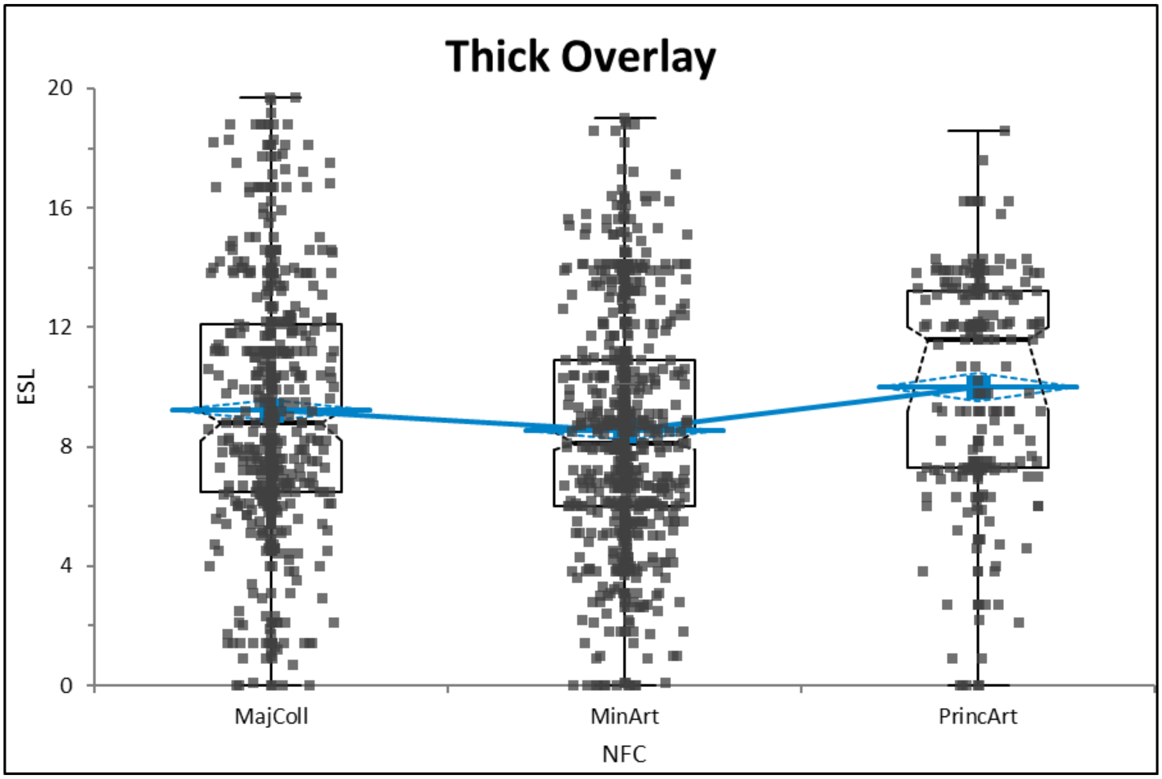

Figure 36: Thick overlay segment distribution by National Function Class

5.15.3 By Number of Lanes

Examining the data based on the segment's number of lanes enables analysis of how the ESL differs when lanes differ. Most of the road miles classified as two-lane; too few road miles classified in the other number-of-lane categories to compare treatments by number of lanes. Table 6 summarizes the mileage breakdown by number of lanes and treatment class. The 0.39 miles (0.628 kilometers) marked "N/A" appeared to be mislabeled route(s).

Table 6: Mileage Breakdown by Number of Lanes and Treatment Class

Treatment Classification	1	2	3	4	5	6	N/A
Heavy CPM	0.2	1143.059	25.013	19.139	18.956		
Rehabilitation	0.041	440.465	16.71	9.419	12.301	0.57	0.39
Reconstruction		19.54	2.249	0.363	1.359		
Total	**0.241**	**1603.064**	**43.972**	**28.921**	**32.616**	**0.57**	**0.39**

5.15.4 By Region

Examining the data based on regions aims to allow for analysis by similar traffic patterns, population density, and material and construction costs. The *2009 TAMC Local Agency Assessment of Average Cost Report* grouped areas of Michigan by region: northern region, southern region, population belt, and cities (their own separate region) (Figure 37).[14] Table 7 shows the mileage breakdown by treatment classification.

[14] From *Estimated Typical Costs for Reconstruction, Rehabilitation and Maintenance Treatments on Local Federal Aid Pavements in Michigan*, Colling, de Melo e Silva and McNinch, 2009.

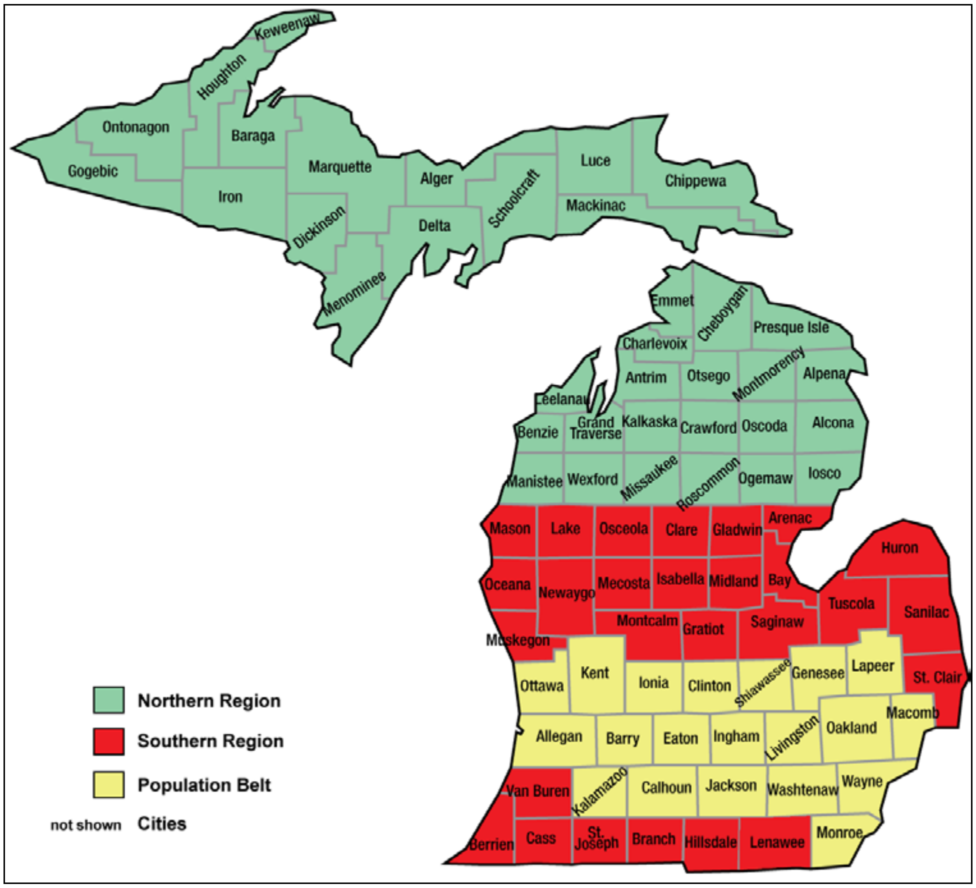

Figure 37: Region Breakdown Map

Table 7: Mileage Breakdown by Region and Treatment Class

Treatment Classification	City	Population Belt	Northern	Southern
Heavy CPM	41.942	133.192	451.857	579.376
Rehabilitation	37.961	66.453	186.573	188.909
Reconstruction	7.748	5.838	9.925	0.000
Total	**87.651**	**205.483**	**648.355**	**768.285**

When broken down by region, chip seal and thick overlay had enough data to show regional differences (Table 8 and Table 9); other repair treatments had too few miles (and segments) to make determinations about regional differences. The population belt and southern regions had enough chip seal and thick overlay miles (and segments) to identify significance (Figure 38 and Figure 39). Both regions' medians show a slight skew compared to the mean for both treatments.

The project team used student *t*-tests to determine whether the ESL results from each of these treatments are statistically discrete from each other. A finding of statistical significance means the variance in the data is minimal enough to detect the differences in central tendency between groups. These data sets exhibit statistical significance from each other; however, because other variables that influence the ESL (e.g., policies, soil type, annual snowfall) are not controlled by this study, the causality of this statistically significant difference cannot be determined. One variable—thickness of the HMA overlay for the thick overlay treatment—could be controlled; however, there were not enough segments to determine how thickness affects ESL although the general trend was that more ESL was obtained with thicker overlays.

Table 8: Mileage Breakdown of Chip Seal Treatment by Region

Agency Region	Agencies Using	Segment Count	Total Miles	Weighted Avg ESL
City	2	21	2.439	2.7
Northern	4	**173**	**78.687**	**5.3**
Population Belt	**7**	**989**	**290.923**	**4.5**
Southern	**8**	**1189**	**412.809**	**3.7**
Total	**21**	**2372**	**784.858**	

Table 9: Mileage Breakdown of Thick Overlay by Region

Agency Region	Agencies Using	Segment Count	Total Miles	Weighted Avg ESL
City	7	458	37.113	9.6
Northern	3	**148**	**56.403**	**10.3**
Population Belt	**6**	**568**	**99.133**	**9.2**
Southern	**9**	**410**	**109.111**	**8.2**
Total	**25**	**1584**	**301.760**	

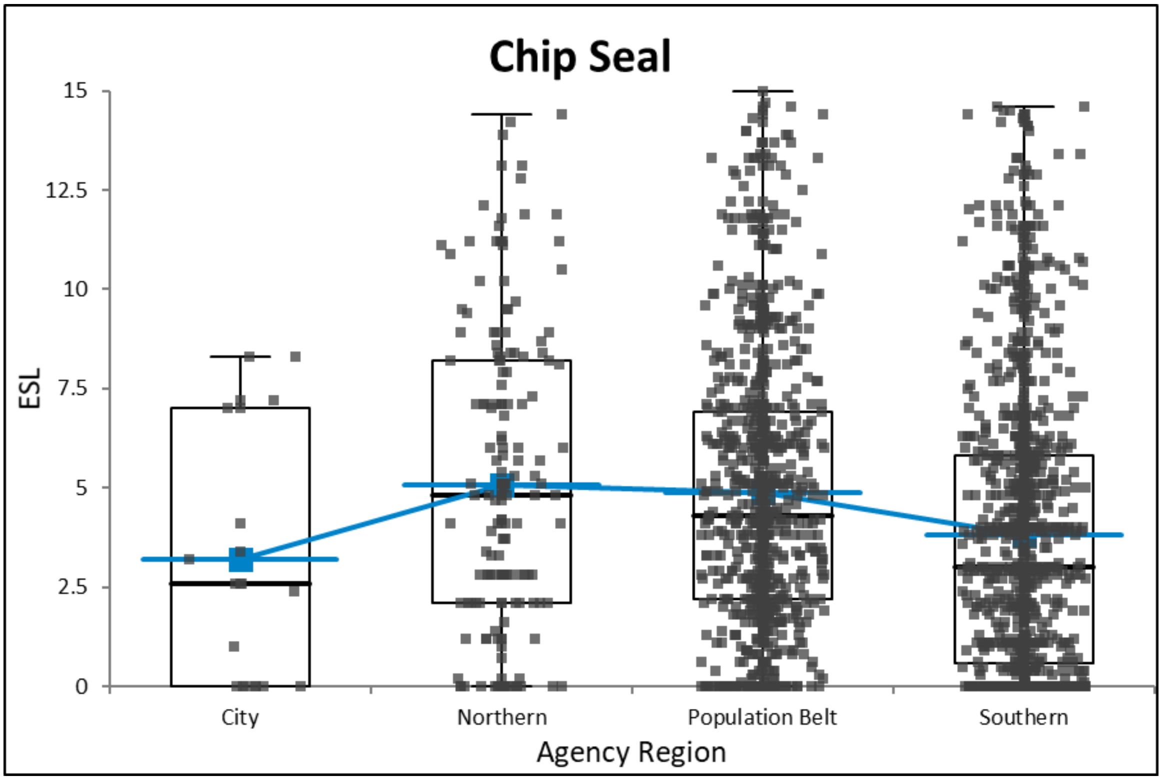

Figure 38: Chip seal non-weighted average ESL segment distribution by region

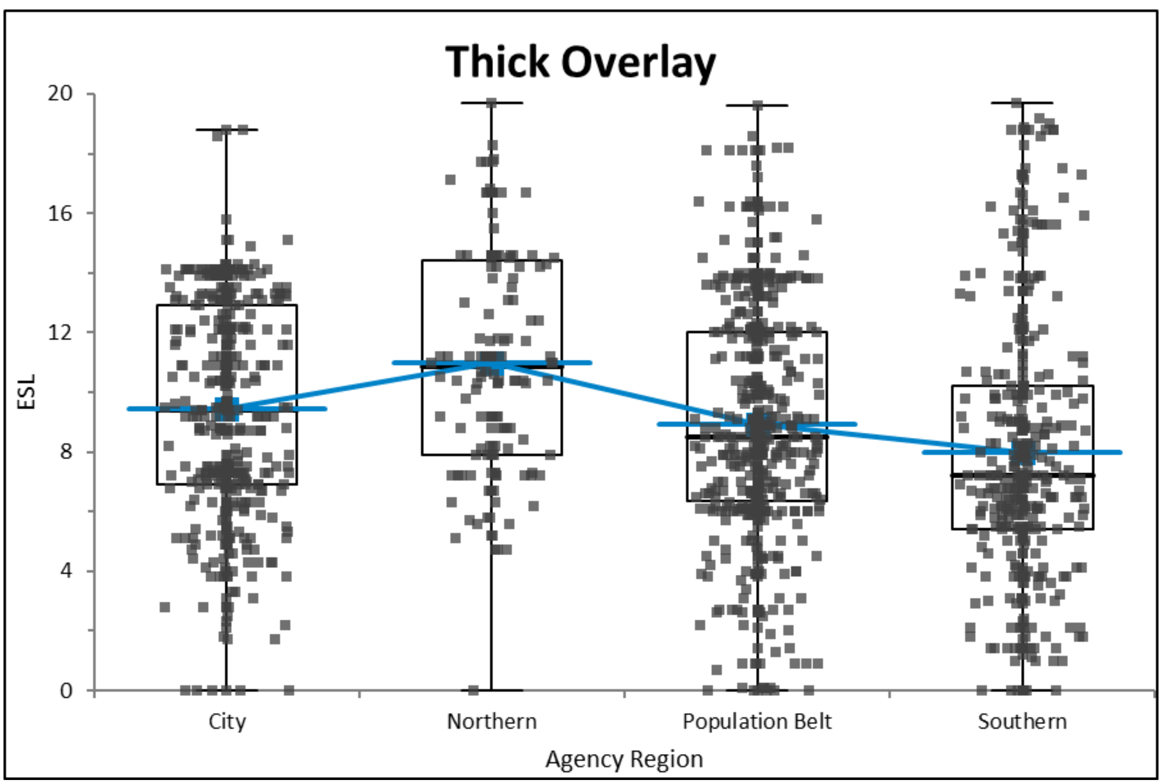

Figure 39: Thick overlay non-weighted average ESL segment distribution by region

5.16 Later-Life Chip Seal Treatments

Local agencies have long used chip seal treatments, which have a shorter service life than other common treatments (such as HMA overlays). This combination of widespread use and a short service life allows for analysis of successively-applied chip seal treatments.

The majority of this analysis looked at segments with no prior treatments. Table 10 shows a breakdown of a unique data set by zero to six prior chip seal treatments. The zero, one, and two prior chip seal treatments categories also had enough miles (and segments) to assess the statistical significance of their central tendency. Eight agencies had segments in each of these three categories (0, 1 and 2 prior treatment). The project team ran the student's *t*-test on these eight agencies' segment distribution; they determined that the central tendency of the data sets are statistically different from each other. The weighted average ESL for segments with one prior treatment decreased to 3.8 years from 4.1 years for segments with no prior treatments. A histogram distribution for segments with zero or one prior chip seal treatment shows a fairly-uniform decrease in frequency of segments achieving longer ESLs (Figure 40 and Figure 41). In contrast, the histogram distribution for segments with two prior chip seal treatments shows a less-uniform decrease in frequency of segments achieving longer ESLs, especially between eight and twelve years of ESL (Figure 42). The weighted average ESL for one prior chip seal treatment (3.8 years) was less than two prior chip seal treatments (4.5 years). This difference is mostly due to the fact that latter has fewer segments that generate low ESLs.

An increase in ESL with successive applications of treatment is unexpected if all things were equal for these two groups, however, it is likely that other factors are present such as more carefully selecting treatment locations.

Table 10: Treatment Breakdown of Prior Chip Seal Treatment(s) by Segment, Miles, and Weighted Average ESL

Prior Chip Seal Treatments	Number of Agencies	Segment Count	Total Miles	Weighted Avg ESL
0	**21**	**2372**	**784.858**	**4.1**
1	**15**	**1045**	**399.986**	**3.8**
2	**9**	**303**	**103.686**	**4.5**
3	5	59	20.599	5.3
4	2	5	2.433	4.9
6	1	1	0.509	3.8
Total	**21**	**3785**	**1312.071**	

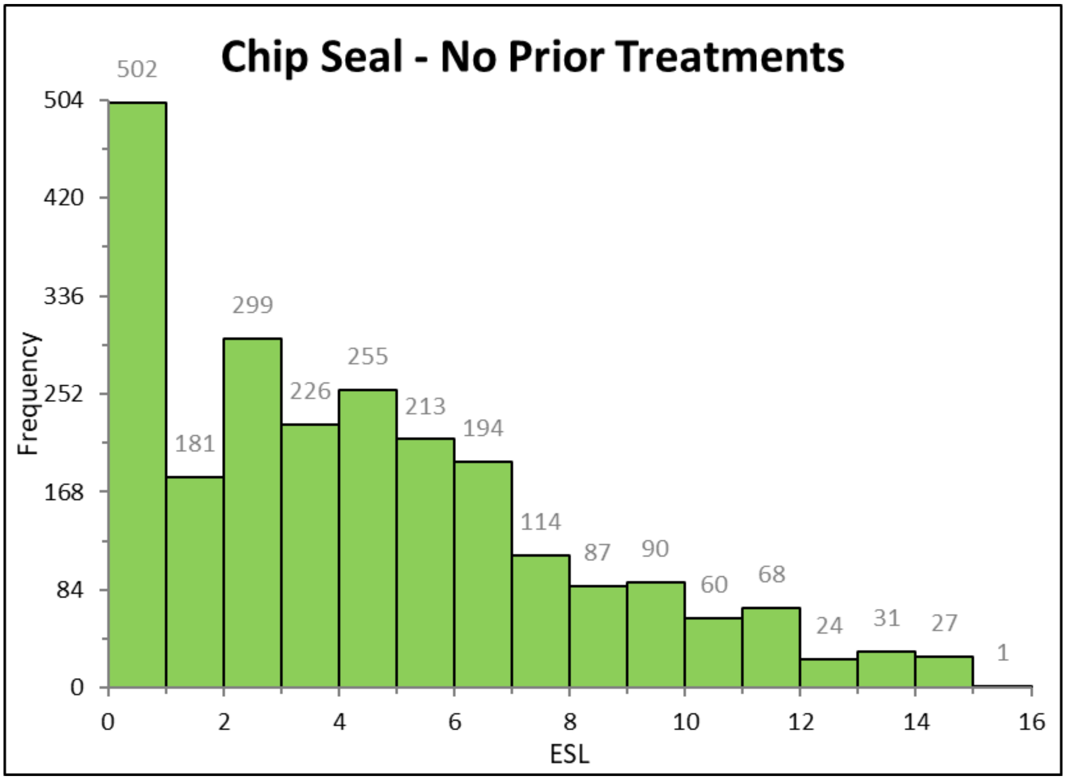

Figure 40: No prior chip seal treatment ESL segment count

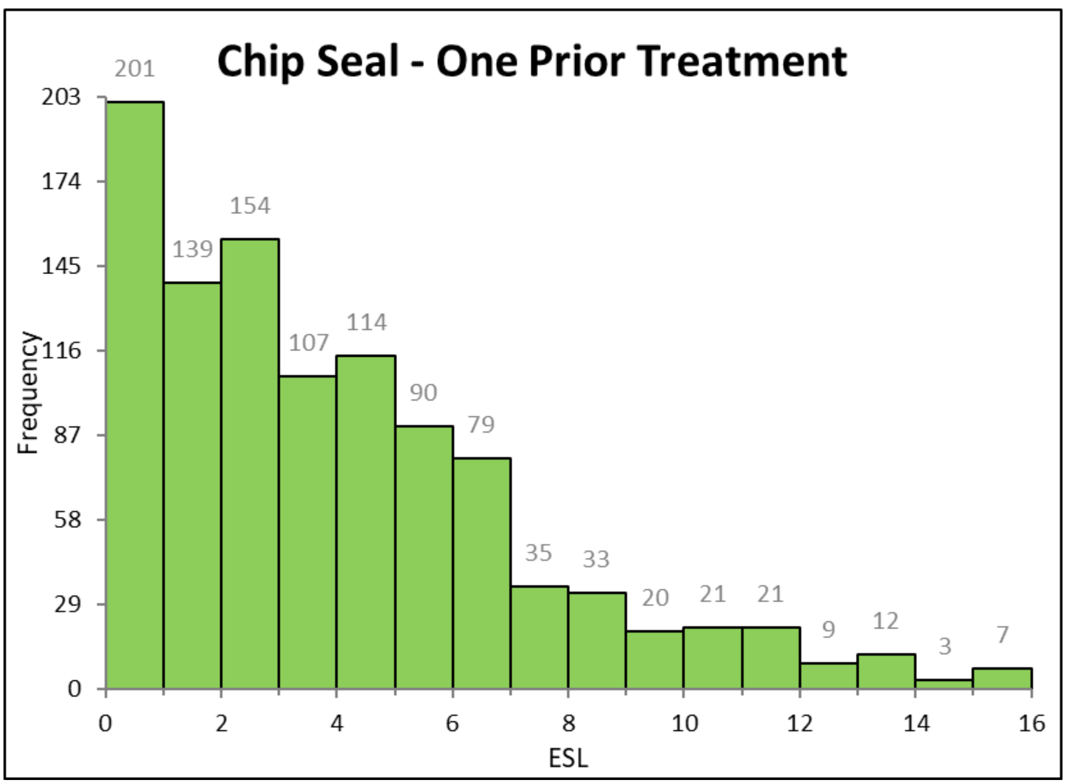

Figure 41: One prior chip seal treatment ESL segment count

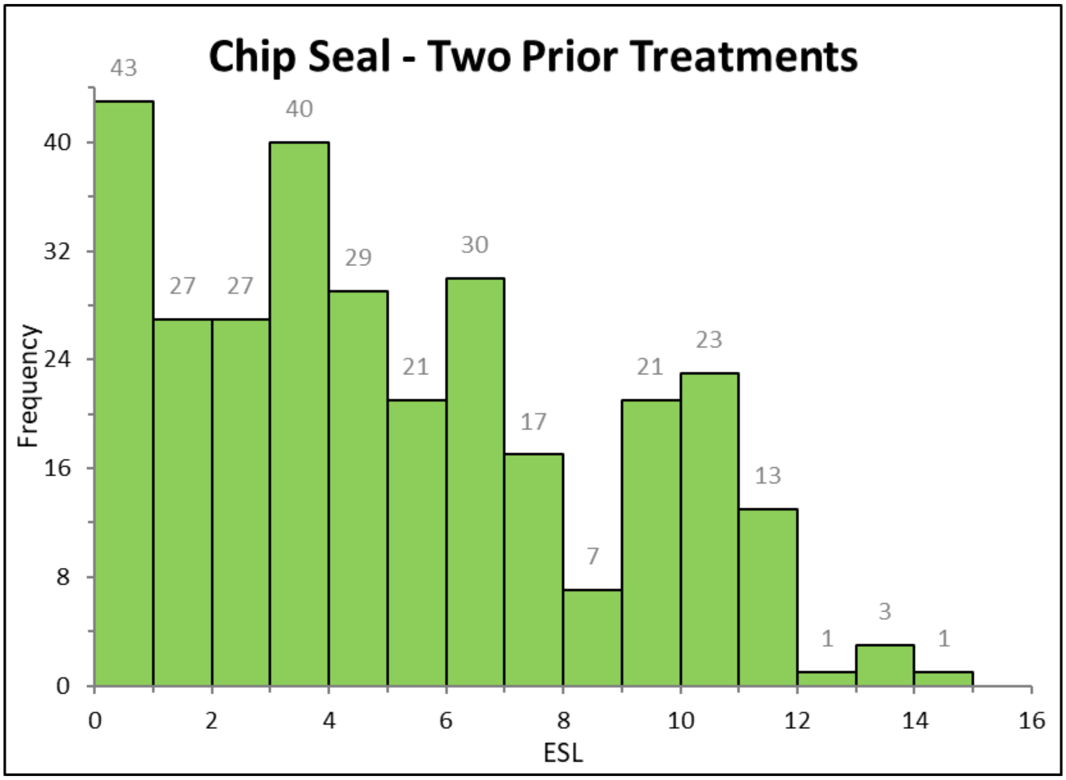

Figure 42: Two prior chip seal treatments ESL segment count

6 DISCUSSION TOPICS

6.1 Conservative Nature of the Study Results

The results from this study should be considered the minimum years of ESL gained by the analyzed treatment. The CTT made every reasonable effort to be conservative in the selection of roadway segments for analysis by using very stringent criteria. Decisions made during the study minimized software-related modeling effects unlike many contemporary studies that rely heavily on modeling repair treatments by aggregate data sets. Individual evaluation of pavement performance models further allowed for an assessment of the reasons for each segment's data fit, which is not possible in aggregate data modeling.

In many instances, the underlying pavement deterioration curves were well-defined by three rating points prior to and three rating points following the CDP (PASER 4 line). This eliminates the effect of modeling on the underlying pavement deterioration curves because the results rely on actual rather that hypothetical data. Similarly, the same practice applied to repair treatment curves, which relied on the presence of a PASER 4 or below score following treatment. The decision to use actual PASER 4—when available—as the ESL measure point also eliminated modeling bias.

Limiting segments with unusually high ESL to a maximum of 15 years ESL for heavy CPM and 20 years ESL for rehabilitation affected 162 heavy CPM segments and 180 rehabilitation segments. The weighted average ESL of these long-life treatments was 26.0 years for heavy CPM and 28.0 years for rehabilitation. Many of these cases were similar to the case shown in Figure 43 where the underlying pavement deterioration curve fit the data well and the repair treatment was clearly performing well according to performance data, however it had a large span of years between the last rating point and the CDP. In this case, it is clear that the repair treatment provided a benefit although the project team believes that additional data points in future years may drastically change the anticipated CDP projection of the model. Limiting the 162 heavy CPM segments to 15 years ESL and the 180 rehabilitation segments to 20 years ESL reduced the statewide weighted average by 0.89 and 1.31 years, respectively. A Minnesota study suggest that 12 or 15 years of ESL is possible for chip seals on properly selected projects, which was the basis for selecting 15 years as the maximum ESL[15]. Rehabilitated pavements would not be expected to last longer than 20 years for a statewide observation.

[15] From: *Rebirth of Chip Sealing in Minnesota*, Wood, Thomas J., Olson, Roger C., 1989: Transportation Research Board.

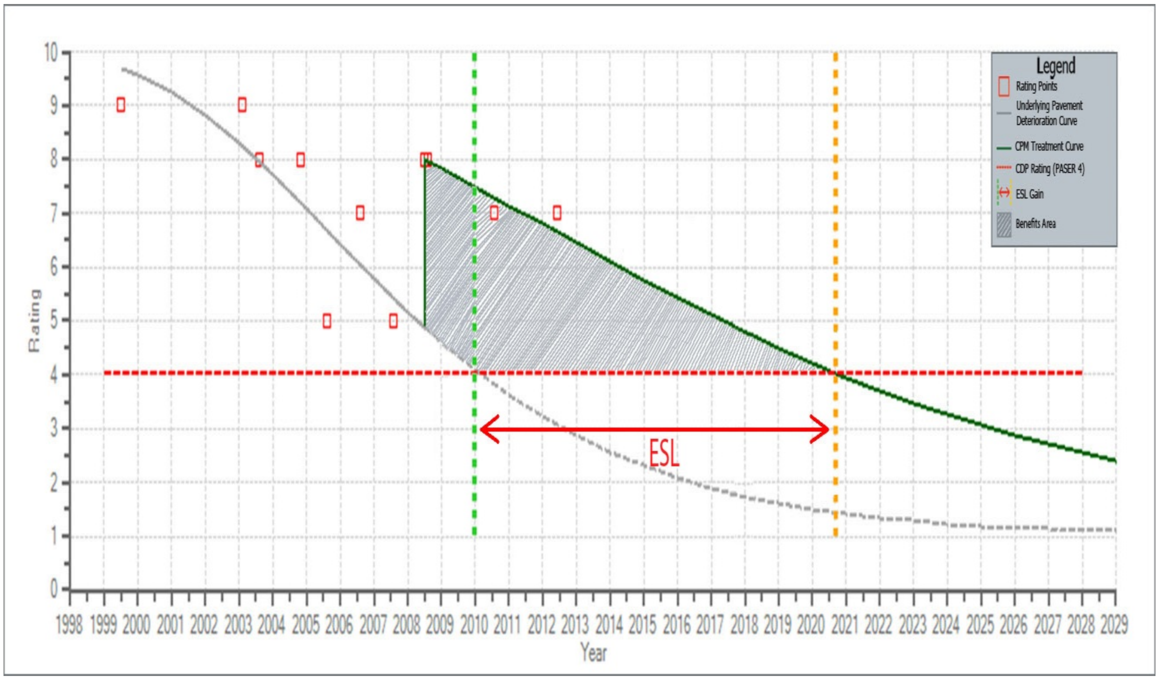

Figure 43: Example of High ESL

6.1.1 Factors Impacting the Effectiveness of Repair Treatments

The effectiveness of any repair treatment depends upon many factors, most of which are difficult to isolate and are highly variable when comparing multiple projects. In general, however, these factors include materials, construction methods, time of application, environmental conditions, and traffic volume. Each of these factors has many sub-variables. For example, the life of a chip seal can be impacted by construction-related variables, such as[16]:

- Cleanliness of the underlying pavement
- Sweeping and removal of excess stone cover chips
- Number of roller passes used before emulsion breaks
- Temperature of the pavement when the chip seal is applied
- Volume of excess chips placed; excessive aggregate or float
- Weather conditions, moisture, high humidity, temperature
- Proximity of asphalt distributor, chip spreader, and roller
- Equipment calibration.

Construction of the underlying asphalt pavement structure can differ greatly from agency to agency and even between segments of roads within an agency. Repair treatments rely on the underlying pavement structure as some treatments, such as CPM treatments, themselves provide little or no structural benefit. If pavement deterioration is driven by structural distresses, then CPM repair treatments will likely provide little or no ESL although other

[16] From *Minnesota Seat Coat Handbook,* Minnesota Department of Transportation, 2006. Available at: http://www.lrrb.org/media/reports/200634.pdf

benefits may result. Pavements that have sufficient structure but are deteriorating due to age-related distresses provide the best base for realizing ESL gains when using CPM treatments. All of these variables result in large variances in ESL gain from project to project.

6.1.2 Low to Zero ESL Gain

The study identified approximately 142 miles (229 kilometers) of treated segments that did not produce a benefit in terms of ESL gain. After application of treatments, condition ratings initially jumped but quickly returned to the underlying pavement's deterioration pattern, thus producing no change in the pavement's predicted intersection with the CDP. Figure 44 illustrates an example of this type of behavior. Repair treatments and even structural improvements that provide no ESL have been observed by many other researchers. Weh-Hou Kuo outlined this behavior for structural overlays in Pavement Performance Models for Pavement Management Systems (MDOT unpublished report, 1995). Low-life extensions after a repair treatment can result from several factors related to either the underlying pavement or the treatment itself.

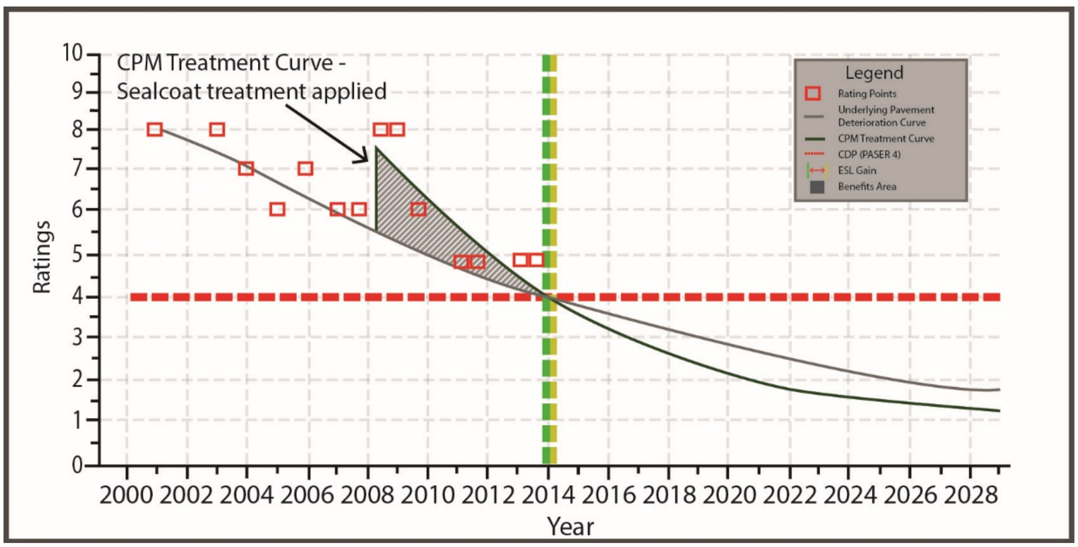

Figure 44: Example of Zero ESL Gain

Repair treatments that are poorly placed with low-quality materials may fail early and constitute a portion of these low or zero ESL cases. Pavements that are deteriorating because of load-related distresses likely comprise a number of these zero ESL cases since repair treatments cannot fix or slow down structural distresses. It is beyond the scope of this study to identify the causes of low or zero ESL cases.

7 CONCLUSIONS AND RECOMMENDATIONS

Data from this study indicated that local agencies were receiving an additional 3 years of ESL by applying fog seal in combination with a chip seal. Chip seal, chip seal plus fog seal, thin overlay, crush and shape, and thick overlay had enough data to deem the ESL findings as significant (Table 11). Also, an ESL decrease of 0.3 years occurs when a chip seal treatment is applied to a pavement with one existing chip seal treatment.

Table 11: Significant ESL Findings

Treatment	Weighted Avg ESL
Heavy CPM	
Chip seal	**4.1**
Chip seal plus fog seal	**7.1**
Thin overlay	**6.9**
Rehabilitation	
Crush and shape	**11.3**
Thick overlay	**9.1**

This study determined that Michigan local agencies are using a wide number of preventive maintenance treatments, and are obtaining ESL gain similar to that of other states.

The seven agencies whose data was not used for this study had submitted a significant amount of data and, after review, it was obvious that they were using asset management principles in their repair treatments. However, these agencies did not have road segments meeting this particular study's rigorous selection criteria.

7.1 Recommendations for Further Research

This study showed that high-quality ESL analyses are possible with the data collected by local agencies on a routine basis. This study also suggests that local agencies have the tools necessary to complete these analyses. The project team therefore recommends the following:

1. The TAMC should consider repeating this study in four to six years when more high-quality data will be available; this will yield a larger data set to analyze.
2. Future research should build upon these findings in order to determine why low or zero ESL gains exist.
3. The TAMC should continue to support and encourage local agencies to collect and evaluate data using pavement management systems, such as Roadsoft, in order to make high-quality ESL analyses easily accomplishable.
4. The TAMC should support agencies in their routine assessment of ESL treatments that they use.

Attachment 4

Analysis of TAMC Investment Reporting Data for Network Level Modeling on the Locally Owned Road System in Michigan

Photo Credit: Alcona County Road Commission

Andy Manty, PE, Research Engineer
Center for Technology & Training

Tim Colling, PhD, PE, Director
Center for Technology & Training

October 25, 2018

Michigan Transportation Asset Management Council

Michigan Technological University
Civil and Environmental Engineering

Center for Technology & Training
Michigan Technological University
309 Dillman Hall
1400 Townsend Drive
Houghton, MI 49931

ABSTRACT

The Michigan Transportation Asset Management Council (TAMC) has been collecting data on pavement maintenance and construction activities via the Investment Reporting Tool (IRT) for several years now. IRT data provides a rich set of infrastructure investment data that can be used for modeling and strategy analysis efforts both on a state and local level. This study evaluates IRT data from 2017 and 2016 for use in modeling efforts.

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EXECUTIVE SUMMARY

Michigan Public Act 499 established the Transportation Asset Management Council (TAMC) to collect, analyze, and report on Michigan's public road network. To accomplish this mission, TAMC has worked with state and local agencies to develop tools, systems, and processes that help roadway owners collect and use roadway asset information. The Investment Reporting Tool (IRT) is of these systems that captures road and bridge construction and maintenance activity from Michigan's 656 local road owning agencies and MDOT.

Road agencies are required to report road and bridge planned and completed construction and maintenance activity annually using the IRT. The IRT data is the most complete source of data for state level condition modeling of Michigan's public roads and bridges. This report analyzes the IRT data collected during 2017 and 2016, and makes recommendations for use of this data at state and local levels for project planning and condition modeling.

The project evaluated data in the IRT data to produce average cost per lane mile figures for four classes of treatments: reconstruction, rehabilitation, heavy preventive maintenance and light preventive maintenance for large cities, counties and small cities. The IRT data was also used to develop estimates of the total quantity of these four treatment classes on local agency roads. The data analysis suggests that IRT data is resilient to common errors in reporting, and produces consistent data that can be used for state and local level modeling and planning.

This study compared reconstruction and rehabilitation projects reported in the IRT, against the against actual bid costs for the reported projects. This analysis indicates that there may need to be clarification on the basis of cost reporting as it relates to preliminary engineering, construction engineering and right of way purchase costs. Overall the impact of these costs appear to be relatively small, effecting primarily the cost of reconstruction and rehabilitation projects. However, more clearly defining the basis of cost with guidance and education would eliminate a source of variability in the IRT data.

1 INTRODUCTION

The Michigan Transportation Asset Management Council (TAMC) was appointed by the State Transportation Commission on September 26, 2002 as required in Public Act (PA) 499. Their mission as defined by this act is to report the condition of the Michigan public road network to the Michigan Legislature [1]. The TAMC's mission is taken directly from PA 499 and states:

> "In order to provide a coordinated, unified effort by the various roadway agencies within the state, the transportation asset management council is hereby created within the state transportation commission and is charged with advising the commission on a statewide asset management strategy and the processes and necessary tools needed to implement such a strategy beginning with the federal-aid eligible highway system, and once completed, continuing on with the county road and municipal systems, in a cost-effective and efficient manner."

The TAMC outlined many tasks necessary to meet the mission of PA 499 and developed these tools, systems, and processes to complete reporting and analysis tasks:

- Investment Reporting Tool (IRT) is the procedure and system developed by the TAMC to meet reporting requirements of Act 499 of 2002 and subsequent amendments. IRT is a statewide road and bridge reporting tool offering a web-based data entry or online reporting from the widely used Roadsoft Asset Management software.

- Act 51 Distribution and Reporting System (ADARS) receives data from the IRT. Local road agencies also report the disposition of funds appropriated, apportioned, or allocated to them under Act 51 on an annual basis using ADARS.

- Pavement Condition Forecasting System (PCFS) receives data from IRT, ADARS, and other sources to help forecast and understand regional and statewide road condition trends.

These systems and tools help local agencies meet reporting requirements while providing road owners, managers, engineers, policy makers, and the public with valuable information on road condition.

Investment reporting data from the Michigan Department of Transportation (MDOT) for state-owned roads were not included in this study because MDOT already has processes in place to report, analyze, and model pavement project data for state-owned roads. Data for state-owned roads are provided as a modeling input for TAMC's pavement model for the state trunk line system under a separate analysis process that is internal to the MDOT.

The IRT study was developed to create modeling inputs for the PCFS system from data reported to TAMC by Michigan's local agencies as part of their annual PA 51 project and financial reporting. Outputs from this study will also provide data that can be used by local agencies in their own modelling or planning efforts. This study provides the following outputs:

1) A subdivided table of average treatment costs per lane mile that can be used for planning the cost of future projects or modeling the state and local road networks;

2) A subdivided project volume for each treatment class that is extrapolated to account for incomplete reporting and can then be used as model input for TAMC's network-level model;

3) Recommendations for the implementation of processes that will routinely produce these results from the raw data in future years.

2 BACKGROUND

Michigan's public road network is owned by 656 local government units (cities, counties and villages) and the State of Michigan, however, a group that is commonly referred to as the "Big 124" owns approximately 92% of the road network. The Big 124 is comprised of Michigan's 83 county road commissions, its 40 largest cities, and the Michigan Department of Transportation (MDOT). The remaining 8% of Michigan's public roads are owned by 533 smaller cities and villages. Most transportation initiatives focus on the Big 124 because this group's behavior can greatly influence transportation sector outcomes for the whole state.

An important part of the asset management process is forecasting asset condition so that maintenance and construction can be planned well into the future and "what if" scenarios can be contemplated. Asset managers typically use condition modeling which helps improve condition forecasts to guide maintenance and construction strategies, rather than relying purely on professional judgement or historic trends. Pavement condition modeling is important on the state level, and is a critical process to fulfill the TAMC's mission to advise the state legislature on the current and future condition of Michigan's transportation assets.

The TAMC has been using network-level models to predict pavement condition on Michigan's public roads for over a decade. The current pavement condition forecast model is called the Pavement Condition Forecast System (PCFS), which was developed by the MDOT. The PCFS is a network-level model that converts broad state-level budgets into discrete categories of maintenance and construction work. The model estimates pavement condition given a planned course of maintenance and construction activity and anticipated annual deterioration rates.

The TAMC has defined four classifications of construction and maintenance work which are the basis for reporting by road owning agencies. These classifications as defined by the TAMC are as follows:

Reconstruction is the removal and replacement of the majority of the structure of a pavement. This includes additions to the base or sub-base of the road. Examples of reconstruction would be crush and shape with the addition of base materials, or the construction of a new road. In concrete pavements, reconstruction includes rubblizing or crushing existing concrete pavement surfaces for use as added base material followed by the construction of a new concrete surfaces.

Rehabilitation is the salvage of the majority of the structure of the pavement, either by adding additional structural components (>1.5-inch overlay) to replace failing ones, or by recycling structural components (crush and shape, warm in-place recycling) for the majority of the pavement. Generally speaking, rehabilitation does not include the addition or replacement of base or subbase material other than recycling of failed layers. In concrete pavements, rehabilitation includes extensive full-depth patching and limited full-slab replacement or overlay with hot mix asphalt (HMA).

Heavy Capital Preventive Maintenance (CPM) are bituminous surface treatments such as slurry seal, chip seal, or thin (<1.5 inch) overlays designed to protect the pavement from water intrusion or environmental weathering without adding significant structural strength. In concrete pavements, patching or repair that is less than 1/3 of the depth of the pavement (partial depth repair) are included in this treatment.

Light CPM are treatments primarily designed to seal isolated areas of the pavement from water (crack and joint sealing), or protect and restore surface oxidation with limited surface thickness materials (fog seal). Generally speaking, light CPM will not provide a corresponding increase in PASER rating when applied.

The PCFS can model three of the four TAMC construction and maintenance classifications: Reconstruction, rehabilitation, and heavy preventive maintenance (shortened to preventive maintenance in PCFS). These three construction and maintenance classifications directly impact road condition ratings when they are applied, resulting in an increase in condition rating. The fourth construction and maintenance classification defined by the TAMC is light preventive maintenance, which is not modeled by the PCFS since these treatments do not directly increase the condition of a pavement as measured by the Pavement Surface Evaluation Rating (PASER) condition system. Light preventive maintenance does provide a material benefit when it is applied to pavements, however this benefit is not readily apparent in the relatively course PASER 10 to 1 rating system.

The main user input page for the PCFS system is illustrated in Figure 1 below.

Pavement Condition Forecast System: NonTrunkline Federal Aid NHS Only

Scenerio Model Name: **Mar 2017 Rev Est; PASER 2013/14 to 2015/16 change matrix**

Project Costs per Lane Mile (Mar 2014)		
Capital Preventive Maintenance (CPM)	$	38,000
Rehabilitation	$	176,318
Reconstruct	$	619,967

First Year of Simulation	2017

Year Discount Rate Begins	2019
Discount Rate (inflation)	4%

Year	Budget	Discounted Budget	% PM	% Rehab	% Repl	Total
2018	$110,000,000	$110,000,000	60%	20%	20%	100%
2020	$110,000,000	$105,769,231	50%	20%	30%	100%
2022	$110,000,000	$97,789,599	40%	30%	30%	100%
2024	$110,000,000	$90,411,982	40%	30%	30%	100%
2026	$110,000,000	$83,590,959	40%	30%	30%	100%
2028	$110,000,000	$77,284,541	40%	30%	30%	100%
2030	$110,000,000	$71,453,902	40%	30%	30%	100%
Total	**$770,000,000**	**$636,300,214.80**				
Annual AVG	***$64,166,667***	***$53,025,018***				

Figure 1: User input page for the TAMC's Pavement Condition Forecasting System (PCFS) illustrating the construction and maintenance cost and budget inputs present in the model. Data Sources

3 DATA SOURCES

3.1 Investment Reporting Tool (IRT)

Michigan Public Act 199 of 2007 requires “The department, each county road commission, and each city and village of this state shall annually submit a report to the transportation asset management council… (which) shall be reported consistent with categories established by the transportation asset management council.” This act requires the reporting of all maintenance and construction activity completed during the year, and requires the reporting of planned maintenance and construction projects for the upcoming three-year window for the entire public road system. The act also requires the reporting of pavement condition data on the federal aid eligible road system, and bridge asset condition data for the entire public road system.

The TAMC developed a web-based system called the Investment Reporting Tool (IRT) to manage the process of reporting planned and completed maintenance and construction activity for roads and bridges. The IRT collects the location, type, and status of individual road and bridge projects as a direct export from the Roadsoft Asset Management system, or manually using a web interface. This versatility is intended to meet the business processes of various sized local agencies while minimizing duplicated effort. The MDOT also provides data to TAMC on state trunkline road and bridge projects through and export of their data management system to the IRT database.

The IRT allows local agency users to enter data on the following fields: a unique project identifier, the date the project was open to traffic, the location of the project, and the classification of the project. Construction cost data can be linked to IRT data through a unique project identifier that connects construction and maintenance costs from the Act 51 Distribution and Reporting System (ADARS) to a respective project in the IRT (see section 3.2 for more information on ADARS reporting). Data from the IRT and ADARS are linked by the unique project identifier.

Reporting project information using the IRT is mandatory for road-owning agencies, and recently the TAMC made a concerted effort to gain compliance. Local agencies are required to check a “reporting complete” box in the IRT after completing data entry or indicating that there were no planned or completed projects.

The IRT includes user access controls to determine whether agencies have logged on to the system and whether they have finished the reporting process by marking their reporting as complete. TAMC monitors use of the IRT and works to improve compliance with agencies that do not complete the process or who have made obvious errors in reporting. Reporting compliance is high, however some of the 656 road-owning agencies do not fully complete the reporting process each year.

Any construction or maintenance project that is complete and open to traffic during the road agency's fiscal year must be reported in the IRT. The reporting deadlines for the IRT follow the individual road agency's own fiscal year definition. The typical fiscal year reporting cycles used by Michigan road owning agencies are October 1, 2016 to September 30, 2017, January 1, 2016 to December 31, 2017, and July 1, 2016 to June 30, 2017. Each of these reporting periods is considered part of the TAMC 2017 IRT reporting set. Agencies have 180 days after the end of their fiscal year to report investments, which means that 2017 was the most current and fully complete IRT data set when this report was written in mid-2018.

The 2017 and 2016 IRT reporting cycles have a higher reporting rate, which positively reflect the efforts to increase reporting. The IRT data sets were received from the Michigan Center for Shared Solutions (CSS) multiple times during this project as local agencies reported data, and reporting compliance was reviewed. Early versions of the IRT database were used for testing and analytical set up. The final production version of the IRT database used for this study was received on August 16, 2018. The database contains 10,685 projects from the 2017 and 2016 reporting cycles, of which 10,190 are local agency projects and 495 are MDOT projects.

Data was filtered from the production version of the IRT/ADARS data set to remove MDOT projects, yielding a database containing 5025 local agency projects for 2017, and 5165 local agency project from 2016. To remove likely erroneous entries, analysts discarded projects that were missing data or had project costs less than ten dollars.

In the fiscal year 2017 IRT reporting cycle, 51 of the 656 Michigan local agencies did not fully complete the required IRT reporting, or were under review at the time of analysis, and in 2016 only 45 local agencies did not complete reporting. See Section 5.4 for more detail on incomplete reporting. Project data from local agencies that did not complete reporting, or that were still under review were removed from the analysis in this study because it could not be determined if those reports were complete. Methods for estimating the volume of this missing data are discussed later in this report.

CTT staff manually reviewed the filtered local agency data set to remove bridge, culvert replacement, and gravel road projects. The resulting filtered database is expected to only contain projects on paved roads that were intended to improve pavement condition, and submitted by local agencies that had fully completed the IRT/ADARS reporting process.

Figure 2 below illustrates the process flow used to filter raw IRT/ADARS data and arrive at the final database. Appendix A includes a similar figure for the 2016 data set. In 2017 approximately 9% of the total local agency project dollar value was removed as a result of filtering. Approximately 1.7% of the 2016 local agency project dollar value was removed as a result of these filtering processes. The higher removal percentage in 2017 was several local agency submittals were still being reviewed by the TAMC staff at the time data was received, and as such does not indicate reporting compliance issues.

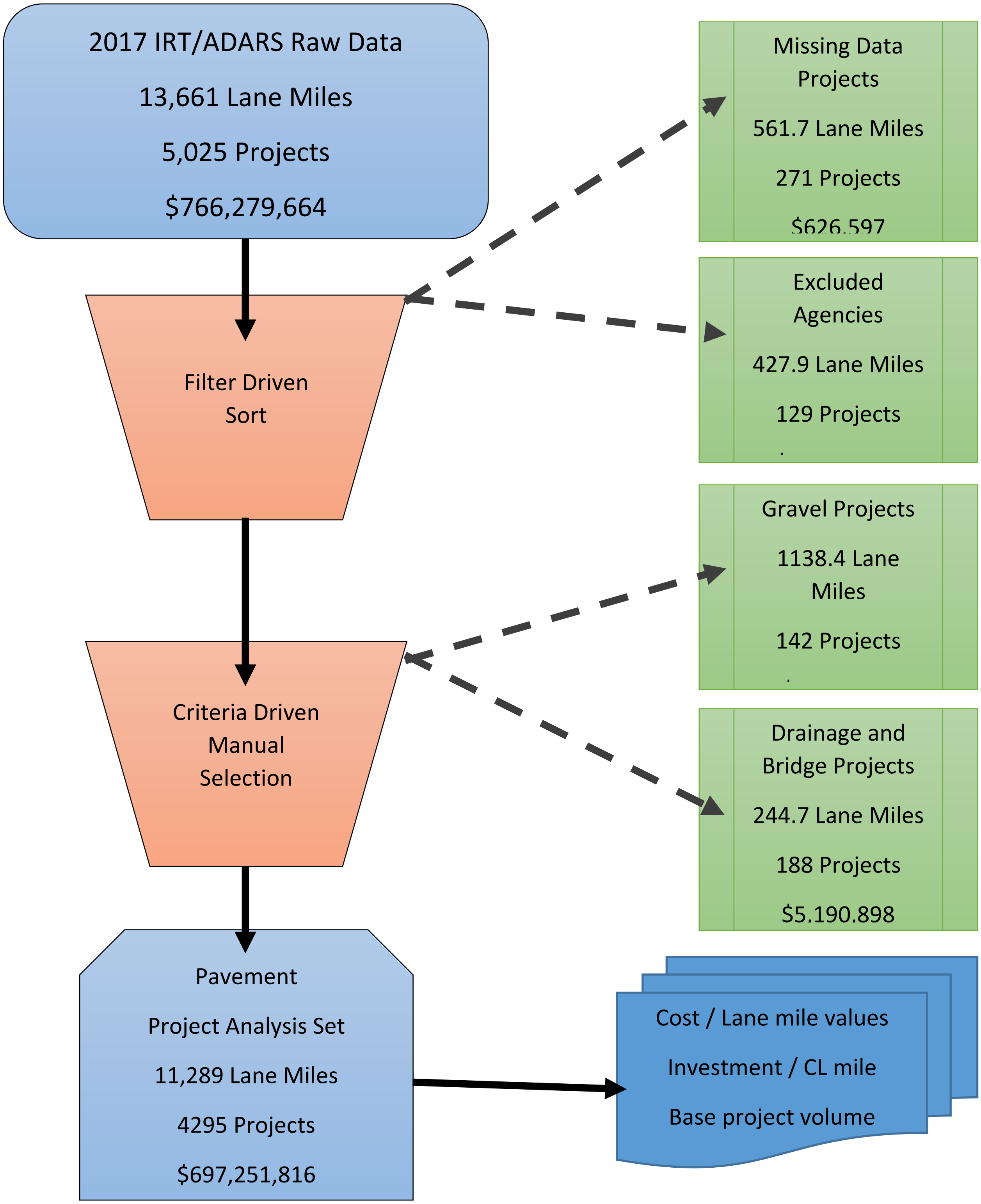


Figure 2: 2017 IRT/ADARS processing to develop analysis data set

3.2 Act 51 Distribution and Reporting System (ADARS)

Michigan local agencies are required to report their annual financial information relating to transportation spending to the Michigan Department of Transportation (MDOT). The MDOT developed the Act 51 Distribution and Reporting System (ADARS), which is a web based tool that streamlines the reporting of financial information. The ADARS system provides a link between the details of the road and bridge construction projects reported in the IRT to financial information for those individual projects. IRT and ADARS project and finance information are linked via a user entered project ID which allows joining of the information in the two databases. ADARS reporting cycles are matched with the IRT reporting cycle. See section 3.1 for details in the IRT.

ADARS data was provided by the Michigan Center for Shared Services (CSS) as a joined data set so that financial data from ADARS was linked to the respective IRT project using the unique project identifier in both data sets. CSS manages both the IRT and ADARS systems.

3.3 Michigan Department of Transportation Bid Letting System

All road construction projects in Michigan on state owned roads, and locally owned road project that use federal dollars must be processed through the MDOT bid letting system. This system processes over a billion dollars in construction and maintenance projects each year between roads owned by MDOT and local agencies. At least once per month bid openings are schedule and the resultant bid tabulations are processed through the MDOT letting system.

The MDOT bid letting systems provides very detailed information on individual projects that are put out for bid for contractor consideration. Data includes: a short description of the project detailing the work type and approximate limits, a listing of the types of pay items associated with the project, the quantity of each of the pay items, and the prices contractors bid for the respective items. The letting systems also include the total prices for each contractor that has bid for the project and an engineer’s estimate of costs.

The MDOT bid letting system provides the most extensive single set of bid data for transportation construction projects in the state of Michigan. The system provides a narrative description of the work in each bid project. The bid letting systems only provides basic detail on the extent of the project with respect to the lane miles of pavement treated. Each project includes the details on the mile point of beginning and ending, however there is no data field that provides a square unit of measurement for the number of lane miles of treatment completed or the specific construction and maintenance classification of the project, however, this information can be determined from other data in the system.

Data from local agency owned projects from May 2016 to October 2017 bid lettings were analyzed to determine bid costs for local agency let projects. A total of 1,078 projects were let during this time period in the MDOT bid letting system, which included the 238 local agency owned projects that were open to traffic in 2017.

The area of extent for each project in the bid letting system was determined by locating the project via google maps from the bid description. The width of located projects were determined by finding the number of lanes via Google Street View. The number of lanes estimated from a project was multiplied by the length of the project described in the bid description to develop an estimate of lane miles of activity for each project.

Let projects were classified into the TAMC's four construction and maintenance types based on the project description and pay items present in the bid.

Interpretation on area of extent and project classification are likely to provide a source of error since it is subject to interpretation by people not familiar with the project. This error is likely to overestimate the extent of the project work since project limits outlined in the bid system are typically the maximum extent of all the work on the project and may not actually reflect the extent of pavement work.

Project data from the MDOT's bid letting system were compared both individually and in aggregate to ADARDS and IRT reporting data as an indicator of the cost capture of ADARS reporting.

4 METHODS

4.1 Evaluation of Missing Data Due to Non-Complete Reporting

TAMC has worked with the Michigan Center for Shared Services (CSS) to develop performance metrics to measure compliance with reporting requirements which can also be helpful to estimate the impact of unreported projects from non-responsive agencies. CSS regularly reports the number of local agencies who have not logged in to the IRT system before the reporting deadline, the number of local agencies who have not marked “reporting complete” in the IRT. Both of these cases may result in unreported projects. The TAMC staff review submittals from local agencies to determine if they have met reporting requirements and looking for obvious errors after a submittal has been made.

In 2017 IRT/ADARS data set there were 51 local agencies that either did not fully complete reporting process or still had pending reviews of their submittals. In the 2016 IRT/ADARS data set this number of local agencies was 45. These local agencies are not necessarily out of compliance with reporting requirements, nor does this mean that the agencies did not report projects using the IRT. However, for the purposes of this study these agencies were excluded from the analysis to mitigate any concerns over data quality or completeness.

A summary of the 2017 and 2016 agencies that were excluded from this analysis and the centerline mileage of their respective road networks are listed in Table 1 below.

Table 1: Local agencies that were excluded from this study due to incomplete reporting or pending data review during the 2017 and 2016 IRT/ADARS reporting cycles.

2017 Excluded Agencies by Agency Type	Number of Agencies	Total Centerline Miles	Fed Aid Centerline Miles	Non Fed Aid Centerline Miles
County	8	9214	2540	6674
Top 40 Cities	2	412	119	293
Small Cities and Villages	41	537	100	436
Total	51	10162	2759	7403

2016 Excluded Agencies by Agency Type	Number of Agencies	Total Centerline Miles	Fed Aid Centerline Miles	Non Fed Aid Centerline Miles
County	0	0	0	0
Top 40 Cities	1	155	45	110
Small Cities and Villages	44	829	170	658
Total	45	984	215	769

Projects reported from local agencies excluded from this study constitute 8% by total project dollars in 2017, and 1.6% of the total project dollars reported in 2016. While this percentage is small, it is still worthwhile to estimate the loss of project volume for agencies who did not fully report to remove this as a source of error in modeling or reporting efforts.

Local road owing agencies that were responsive in reporting IRT–ADARSA data can be used as a proxy for agencies that were excluded from this study. The use of peer proxies allows IRT-ADARS data to be expanded to account for missing data in total project expenditures and total lane miles of road projects completed. Two methods for assigning peer proxies are discussed in this section. Method 1 will be demonstrated in section 5.0 of this report.

4.1.1 Method 1: State Average Agency Spending

This method subdivides local agencies in to three groups; Counties, Top 40 Cities, and Small Cities and Villages. These subdivisions are based on the relative proportion of road ownership in Michigan and have a significance in transportation spending. Average project investments per agency owned centerline mile of road were calculated for each of the three local agency groups from investment data that was reported in the IRT. Local agencies that did not complete reporting in the IRT were removed from the calculation of average project investment per centerline mile. The investment rate (average project investment per centerline mile) can be multiplied by the centerline road network size from agencies that did not complete reporting to make an estimate the total missing investments in each of the four TAMC project classifications.

Table 2 below summarizes average annual dollars of project investments per centerline mile as reported in the 2017 IRT-ADARD database.

Table 2: Average annual spending per centerline mile according to 2017 IRT/ADARS reporting.

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ 231	$ 32	$ 865	$ 84	$ 348	$ 77
Heavy CPM	$ 2,439	$ 527	$ 4,263	$ 1,149	$ 3,288	$ 847
Rehabilitation	$ 6,208	$ 897	$ 26,303	$ 4,334	$ 8,652	$ 2,618
Reconstruction	$ 2,940	$ 381	$ 15,288	$ 8,474	$ 11,518	$ 4,059

A similar trend is apparent when analyzing 2016. Table 3 illustrates investment spending per centerline mile analysis from 2016 IRT/ADARS reports.

Table 3: Average annual spending per centerline mile according to 2016 IRT/ADARS reporting

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ 81	$ 14	$ 977	$ 104	$ 372	$ 95
Heavy CPM	$ 2,569	$ 418	$ 5,574	$ 1,648	$ 2,997	$ 1,035
Rehabilitation	$ 6,443	$ 861	$ 18,828	$ 4,874	$ 11,581	$ 1,969
Reconstruction	$ 5,407	$ 577	$ 12,318	$ 5,657	$ 14,205	$ 2,926

This method produces reasonable estimates of unreported project activity by using all agencies in a given year as a proxy for agencies that were excluded from the study. It is specifically usefully when not much is known about the history or level of activity of the excluded agency. Average spending per year should be aggregated over several years as a longer history of these spending trends becomes available. Multiyear averaging minimizes yearly variance in

Reconstruction investments that may be swayed by a few high cost projects on an annual basis. Multiyear averaging is a best practice, but will not significantly impact investment calculations on a state level if it is not completed in the next few years.

4.1.2 Method 2: Planned Projects

IRT reporting data can be estimated for agencies that did not report in a given year or were excluded from the study, but have been responsive in the past. Historic reporting of planned projects provides a reasonable estimate of missing investment data. Previously reported planned projects provide an estimate of the work that likely occurred in a year that no data was reported or where there are concerns over data quality. This method should be used in cases where data is available before considering the use of state average investments from Method 1. The drawback from this method is that most agencies that are unresponsive in a given year, may be more likely not to have provided accurate planned project information in past years. As the TAMC continues to collect and use planned project data this method will become more viable and will likely be the preferred method.

4.2 Basis of Project Cost

Determining the basis of project costs is an important step in any financial reporting and modeling where budgets are used as the basis for determining the lane mile extent of a future work program. The basis of cost for projects used in a modeling or planning effort should always be the same as the budget being modeled to avoid over or under estimation of the value of a given funding level.

The basis of costs determines what is considered included and excluded on when reporting a project cost or a budget. A basis of cost can be all inclusive “agency total cost” by adding non-construction costs for a project such as the cost of right of way purchase, construction and design engineering, construction testing and surveying along with the costs of the physical construction activity.

Costs outside of physical construction costs are more likely to be a significant factor with reconstruction and rehabilitation projects due to their complexity, and are not likely to be as significant on light and heavy capital preventive maintenance projects, which usually do not require significant engineering, testing or surveying services.

The document titled “Instructions for Preparing the Act 51 Street Report for Cities and Villages on the ADARS” provides guidance for the basis of costs of construction and maintenance project reporting. This same guidance is echoed in the ADARS training and the fact sheet “Investment Reporting 101, Key Points on IRT/ADARS – 4/4/2016”. This guidance says:

> “Enter all expenditures for street construction on Major and Local Streets. This category should include expenditures that can be directly assigned to a construction project, (i.e.,

> engineering fees, ROW acquisition, etc.). Include charges for payroll, related fringe benefits, equipment rentals, materials, and contractual services that were charged to a project."

This guidance appears to be all inclusive of expenses for road and bridge projects, however, it unclear if these costs specifically include only construction phase services, or if pre-construction costs such as preliminary design engineering included.

One county finance officers that spoke to the research team indicated that they believed that this guidance may be interpreted differently among local agencies. The finance officer believed that this provision limits reporting of costs to only the current year that a construction project is completed. This understanding of this guidance would exclude design services, and may have a significant impact on the reporting of multiple year construction projects, since only the costs in the final year would be reported.

Correspondence and phone calls with MDOT's Bureau of Transportation Planning indicates that data for IRT/ ADARS reports for MDOT's road projects include construction phase costs only.

> "MDOT only reports on the Construction Costs (This does not include costs associated with Early Preliminary Engineering, Preliminary Engineering, Environmental Clearance, Permitting or Real Estate purchases). It does include Construction Engineering so we are confirming it includes testing, surveying, equipment and materials."

At a minimum it appears that the basis of cost being reported by the MDOT and the local agencies differs in how right of way costs are included or excluded in IRT/ADARS reporting. There also appears to be anecdotal evidence that the open nature of the cost guidance may be interpreted broadly by local agencies. Neither of these items are catastrophic in nature, but are sources of "noise" in the cost per lane mile data.

4.2.1 Impact of Design and Construction Services on Project Costs

Design and construction services are a significant percentage of the total cost of transportation projects. Typically, these costs are expressed as "preliminary engineering" or PE, and "construction engineering" or CE.

Preliminary Engineering is commonly defined as:

> "[P]lanning and design of a highway project first receives funding authorization for planning and/or design activities. The delivery of the construction documents used for solicitation of construction contract bids (known as project letting) marks the end of PE." (Hollar, 2011)

Construction engineering or CE includes professional services necessary for the contractor to construct the job. This can include surveying, field engineering, inspection and testing by the project owner.

PE and CE are most often these costs are expressed as a percentage of the physical cost to construct the transportation project. A literature review of states that have published data on design and construction cost contributions to total project cost indicate that the project size, complexity and work type all contribute to the relative expense of design and construction services necessary to deliver a project.

In 2002 Washington Department of Transportation (WashDOT) completed a national survey of PE and CE costs on specific road construction projects which included bridge and road components (Highway Construction Cost Comparision Survey, 2002). This survey remains one of the most cited pieces on the topic of PE and CE costs. Analysis of the data from 24 state departments of transportation that responded to the WashDOT survey indicated PE costs typically averaged about 10.3% of physical construction costs and CE averaged 11% of construction costs. The MDOT response to this survey indicated that PE was 8% of physical construction costs and CE ranges from 0 to 15% of physical construction costs.

CE and PE costs conservatively add between 21 to 27 percent of the physical construction cost for DOT projects that are of a similar size typical local agency reconstruction and rehabilitation projects. In Michigan on the federal aid eligible road system it is reasonable to expect that these PE and CE percentage would be similar for local agency owned reconstruction and Rehabilitation projects.

5 RESULTS

5.1 IRT/ADARS Project Cost Results

Raw data from the 2017 IRT/ADARS submittals were processed to isolate local-agency road projects by removing any bridge projects and removing any projects on state-owned roads. The local-agency road data set was then filtered to remove projects from local agencies that had not fully completed the report process, or whose data was still under review by the TAMC. See section 4.1 for details. Projects which did not contain cost data were also removed from the analysis set.

The data from the analysis set was subdivided into the four TAMC treatment classifications and separated based on road system category. The total dollars of projects in each of these subdivided categories were divided by the total lane miles of projects in that respective category to produce a weighted average cost per lane mile for each specific class of projects. This technique of weighting projects by the number of lane miles assigns more significance for bigger projects rather than assuming all projects are of equal value. Weighting by lane miles makes it less likely that data errors or small, high cost projects will influence the calculated cost per lane mile figures.

The percentage on a dollar basis was calculated for each of the specific treatment classifications. The summarized IRT/ADARS average cost per lane mile data at the statewide level for 2017 are presented in Table 4. This table provides inputs for the PCFS model.

Table 4: Statewide IRT/ADARS project cost data for 2017.

All Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Total	Dollars/LM
Light CPM	837	2,264.2	$ 10,840,529	1.55%	$ 4,788
Heavy CPM	1,756	5,547.3	$ 115,921,824	16.63%	$ 20,897
Rehabilitation	1,218	2,766.2	$ 321,777,460	46.15%	$ 116,326
Reconstruction	484	711.5	$ 248,712,003	35.67%	$ 349,545
Totals	***4,295***	***11,289.1***	***$ 697,251,816***		
Federal Aid Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	400	1,672.5	$ 7,551,626	2%	$ 4,515
Heavy CPM	572	3,343.0	$ 67,114,433	17%	$ 20,076
Rehabilitation	419	1,600.7	$ 208,974,236	52%	$ 130,552
Reconstruction	168	350.7	$ 120,087,742	30%	$ 342,451
Totals	***1,559***	***6,966.9***	***$ 403,728,036***	100%	
Non Federal Aid Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	437	591.6	$ 3,288,903	1%	$ 5,559
Heavy CPM	1,184	2,204.2	$ 48,807,391	17%	$ 22,143
Rehabilitation	799	1,165.5	$ 112,803,224	38%	$ 96,787
Reconstruction	316	360.9	$ 128,624,260	44%	$ 356,439
Totals	***2,736***	***4,322.2***	***$ 293,523,779***	100%	

The weighted average cost data used for this study contained a number of projects that appeared to be outliers from a cost per lane mile standpoint. Many of these outliers were projects with very short segment lengths, which led to a large cost per lane mile calculation. At least one of these outliers appears to be a representation of an agency wide crack sealing program that was placed on a single segment of road because the individual locations were not known. The impact of these outlier projects was investigated by performing a sensitivity analysis.

The sensitivity analysis removed projects with a total size of less than 0.2 lane miles, which equates to approximately 528 feet long by two lanes. This length was chosen because it is less than a typical city block. Projects that appear to be in the wrong treatment classification were also removed from the analysis to test the impact of data errors. Comparison of the altered data set used for the sensitivity analysis with the statewide average for light CPM, heavy CPM, rehabilitation, and reconstruction found in Table 4 reduced weighted average cost per lane mile results by 1.91%, 1.07%, 1.80%, and 2.58%, respectively. Changes in results of this magnitude were not considered to be significant considering other sources of variation.

The weighted average cost per lane mile calculations of the four project classifications have been further subdivided by agency type (County, Top 40 City and Small City) and are included in Appendix B. Data tables in Appendix B include data for 2017 and 2016.

Several trends were apparent from the IRT/ADARS project cost per lane mile data. County road commission projects typically had the lowest cost per lane mile, followed by small cities and villages, with the Top 40 Cities having the largest cost per lane mile. Federal aid projects were typically cost more per lane mile than non-federal aid eligible projects with the exception of light CPM in all city categories, and reconstruction for the top 40 cities. Figure 3 below graphically illustrates the calculated cost per lane mile data from 2017.

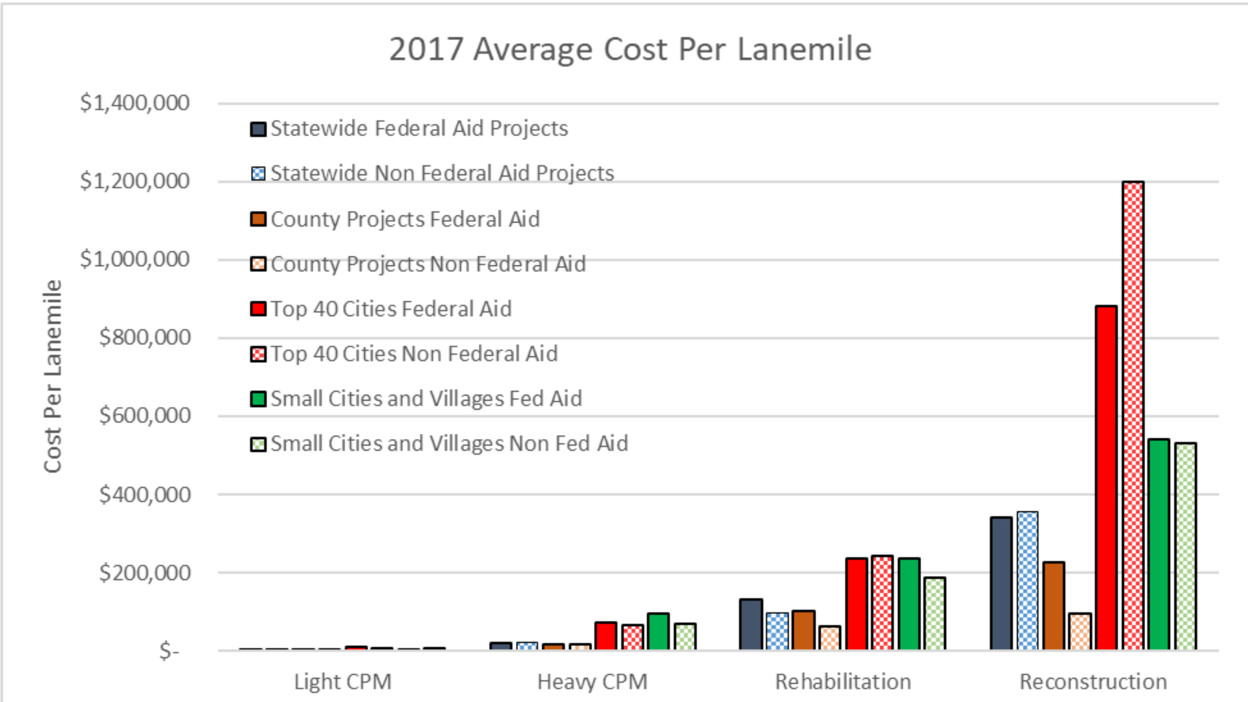


Figure 3: 2017 Weighted average project cost per lane mile data from IRT/ADARS system

Figure 4 below illustrates the total lane miles of local agency projects in the 2017 IRT data set after filtering described in Section 3.1. As previously discussed, this data is a subset of all the reported data which represents about 92% of the 2017 IRT/ADARS local agency submittal. This figure illustrates the relative impact that county road commissions activities have on the overall local agency own system due to their high volume of project work. Data from 2016 exhibits a similar pattern.

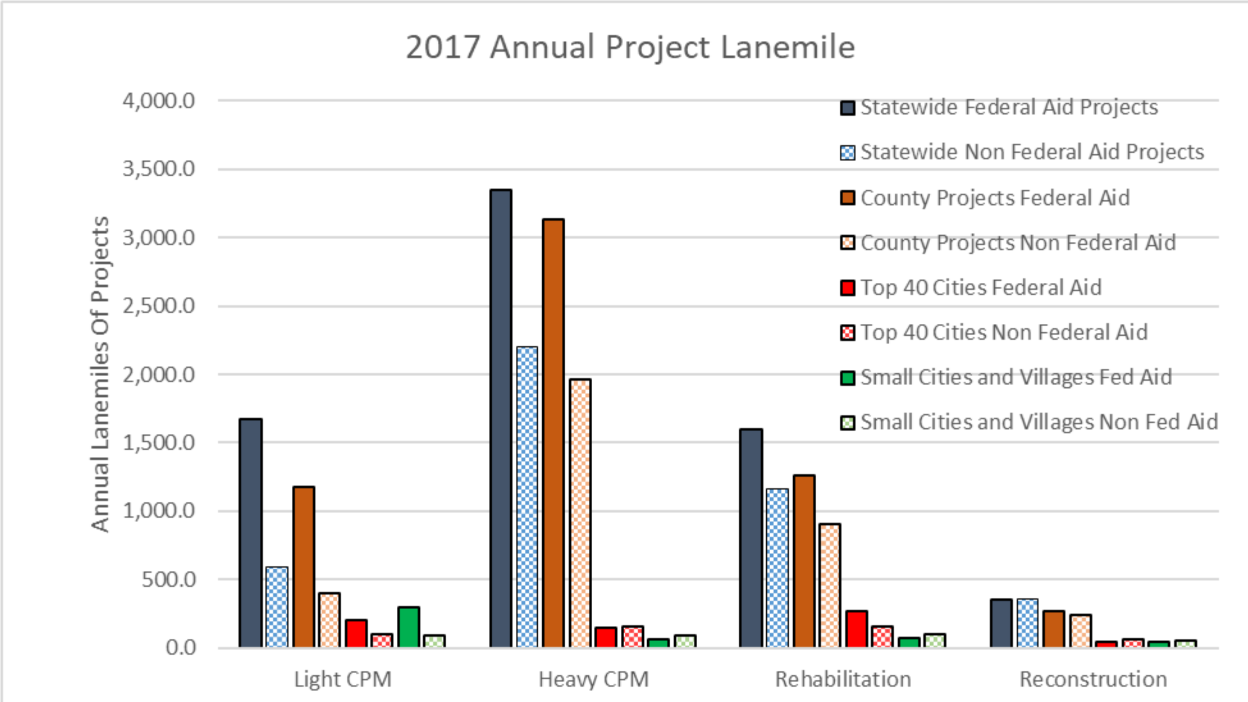


Figure 4: 2017 Total lane miles of road projects in the analysis set separated by agency type from IRT/ADARS reporting

Figure 5 below illustrates the total dollars in the analysis set and in each project classification respective of local agency type after filtering described in Section 3.1. County road commission spending in rehabilitation and light and heavy preventive maintenance represent the majority of the dollars in these categories. However, reconstruction dollars for counties and the top 40 cities are almost identical in total volume.

The project cost per lane mile and total volume differential between cities and counties are both significant for state level modeling efforts. Reconstruction and rehabilitation in cities are a small portion of the total miles of road work completed every year, however, they constitute a very significant total dollar volume.

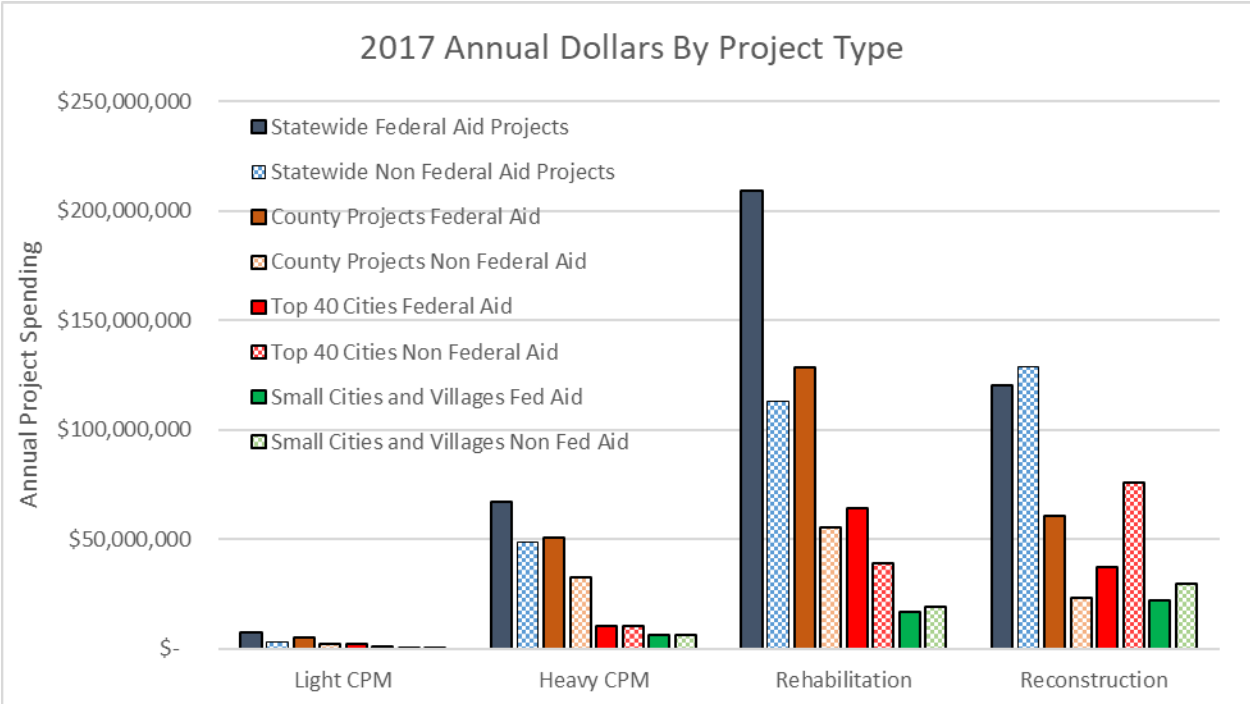


Figure 5: 2017 Total dollars of projects by agency type contained in the analysis set from IRT/ADARS Reporting

Data shown in Figure 3, Figure 4, and Figure 5 for 2016 IRT/ADARS reporting are included in Appendix B.

5.1.1 Analysis of IRT/ ADARS Data for Common Treatments

The IRT-ADARS data set was analyzed using the common treatment name to break down the four treatment classifications into their component treatment types. Projects with similar common treatment names were aggregated and compared as a group. Projects that did not include a common treatment name or where the intent of the common treatment name was unclear were excluded from the analysis. Groups of common treatment names that did not include over 40 individual projects were aggregated with another similar group when possible.

Table 5 and Figure 6 below illustrate the average weighted cost per lane mile data for common treatments identified in the combined 2017 and 2016 IRT/ADARS data set. The cost per lane mile calculations of the common treatments have been further subdivided agency type (County, Top 40 City and Small City) and are included in Appendix C. Calculations in Appendix C include data for 2017 and 2016.

Table 5: 2017 and 2016 IRT/ADARS average weighted cost per lane mile calculations for common local agency treatments at a state level.

2016 & 2017 Statewide Projects					
TAMC Class	Project Subcategory	# of Projects	Lane Miles	Total Project Dollars	$/LM
Heavy CPM	Chip Seal	1918	7937.2	$ 97,255,143	$ 12,253
Heavy CPM	Slurry or Cape Seal	112	510.1	$ 9,961,373	$ 19,528
Heavy CPM	Micro Surfacing	233	270.7	$ 8,739,353	$ 32,281
Heavy CPM	Ultra Thin Overlay	115	288.1	$ 10,595,521	$ 36,780
Heavy CPM	Mill and Fill - Non Structural	412	437.0	$ 44,946,306	$ 102,855
Heavy CPM	Overlay - Non Structural	652	1133.0	$ 63,980,522	$ 56,468
Rehabilitation	Mill and Fill - Structural	180	284.8	$ 38,887,034	$ 136,538
Rehabilitation	Overlay - Structural	566	1044.3	$ 101,343,033	$ 97,046
Rehabilitation	Crush and Shape	474	940.6	$ 143,728,966	$ 152,804
Rehabilitation	Minor Rehab	142	308.2	$ 20,769,477	$ 67,393
Rehabilitation	Major Rehab	101	373.0	$ 62,881,715	$ 168,567
Rehabilitation	Resurfacing	810	1762.1	$ 242,868,181	$ 137,825
Reconstruction	Reconstruction	766	1126.9	$ 435,638,749	$ 386,598

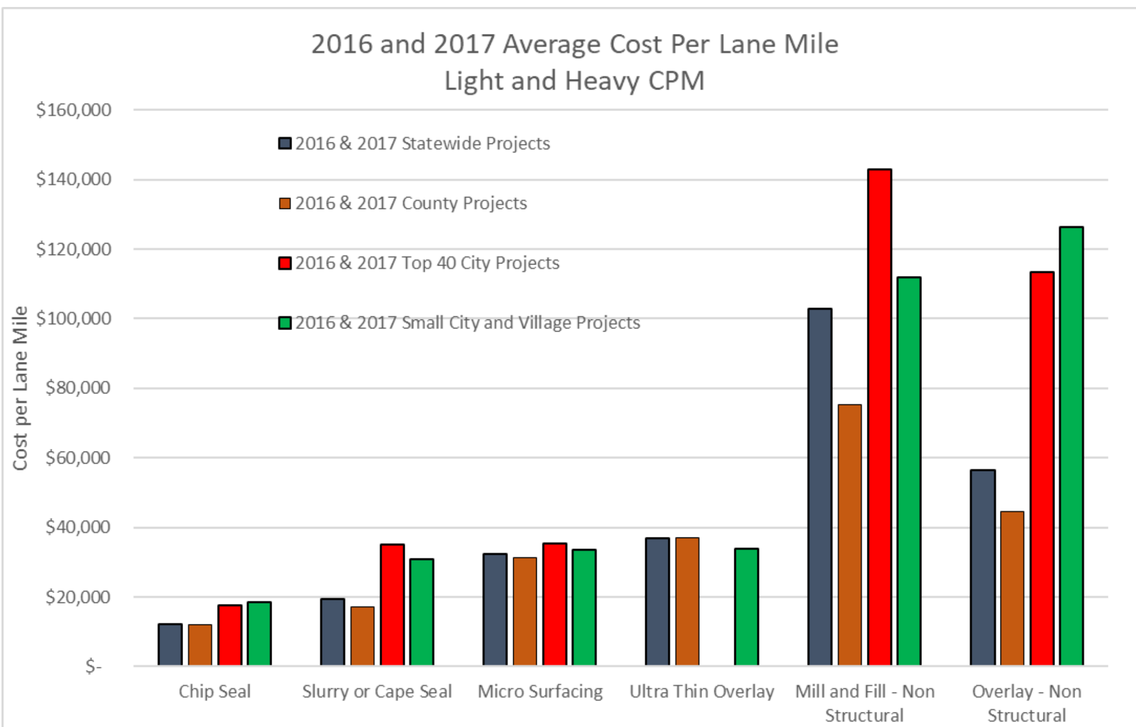


Figure 6: Weighted average cost per lane mile for common preservation treatments

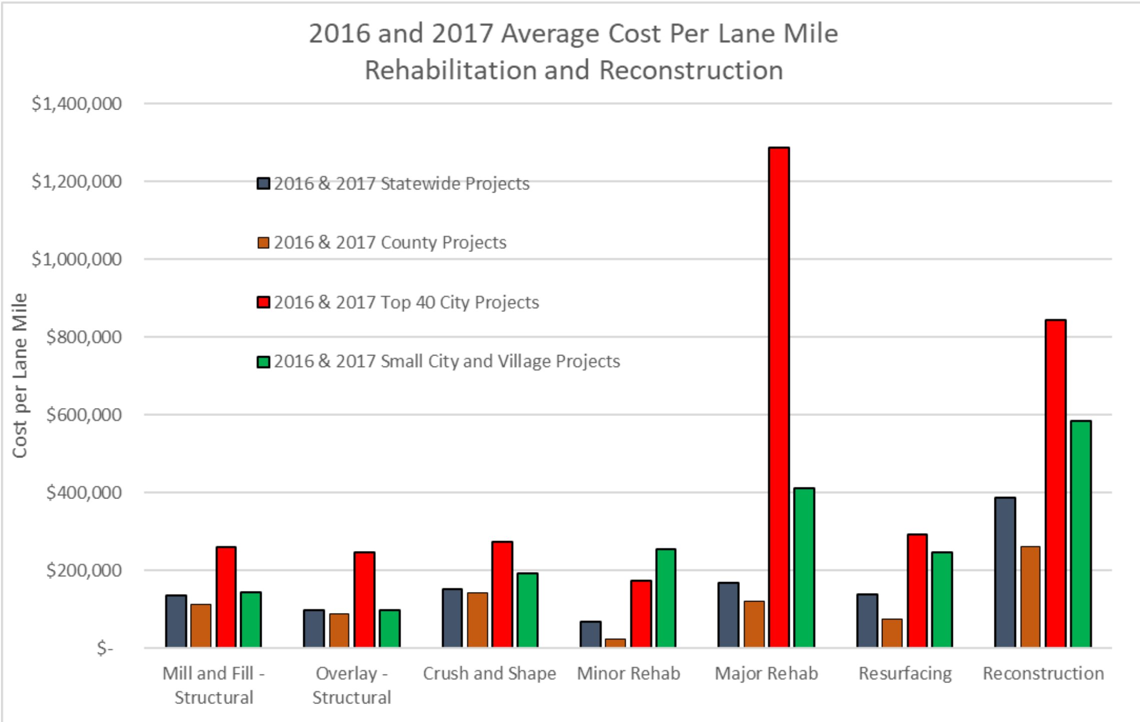


Figure 7: Weighted average cost per lane mile for common structural treatments

5.2 Treatment Volume Results

Analysis of IRT/ADARS reporting compliance from 2017 indicates that a very small number of local agencies did not fully complete reporting of completed projects in the IRT, and only a few of these agencies were still being reviewed by TAMC staff. These local agencies and the data that they submitted were removed from the analysis of this study to avoid any concerns over data quality or completeness.

The local agencies that were responsive to reporting can be used as a proxy for non-responsive agencies by the use of average project investments per centerline mile as previously calculated in Table 2 and Table 3. The excluded agencies and the centerline miles of road that they represent by agency type and project classification are illustrated in Table 1. Multiplying unreported lane miles in Table 1 by the respective investment per centerline mile factors from Table 2 and Table 3 results in an estimate of unreported dollars in each project classification for the respective years. Table 6 illustrates the estimated unreported investments for 2017 as a result of excluding local agencies from this study. This data is the product of Table 2Table 1 and Table 2. This unreported investment is $57 million total dollars, which is 8.2% of the total local agency spending in 2017.

Table 6: Estimate of unreported investments from agencies not completing reporting in 2017.

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ 586,931	$ 215,494	$ 102,969	$ 24,514	$ 34,968	$ 33,555
Heavy CPM	$ 6,194,322	$ 3,520,297	$ 507,646	$ 336,328	$ 329,966	$ 369,599
Rehabilitation	$ 15,765,603	$ 5,984,480	$ 3,132,299	$ 1,268,697	$ 868,104	$ 1,142,333
Reconstruction	$ 7,465,396	$ 2,544,172	$ 1,820,615	$ 2,480,701	$ 1,155,760	$ 1,771,034
Total	**$ 30,012,252**	**$ 12,264,442**	**$ 5,563,529**	**$ 4,110,240**	**$ 2,388,797**	**$ 3,316,521**

Unreported investments for 2016 were calculated using this same technique using the product of Table 1 and Table 3, and are illustrated in Table 7 below, with an unreported investment total of $11.9 million.

Table 7: Estimate of unreported investments from agencies not completing reporting in 2016.

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ -	$ -	$ 43,744	$ 11,501	$ 63,356	$ 62,783
Heavy CPM	$ -	$ -	$ 249,506	$ 181,776	$ 510,018	$ 681,377
Rehabilitation	$ -	$ -	$ 842,735	$ 537,740	$ 1,971,084	$ 1,296,647
Reconstruction	$ -	$ -	$ 551,353	$ 624,102	$ 2,417,723	$ 1,926,282
Total	**$ -**	**$ -**	**$ 1,687,339**	**$ 1,355,119**	**$ 4,962,181**	**$ 3,967,088**

The unreported local agency spending from Table 6 and Table 7 is added to the results of the IRT/ADARS reported spending to produce a total estimated spending for each of the four treatment categories and the three agency classifications, and are illustrated in Table 8 and Table 9 below. These two tables represent the suggested modeling inputs for the PCFS model.

Table 8: Total estimated local agency spending in 2017 adjusted for agencies that did not fully report IRT/ADARS data

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ 5,365,296	$ 2,198,684	$ 2,207,720	$ 774,144	$ 703,478	$ 589,638
Heavy CPM	$ 56,624,000	$ 35,917,636	$ 10,884,206	$ 10,621,264	$ 6,638,160	$ 6,494,715
Rehabilitation	$ 144,117,718	$ 61,059,729	$ 67,158,246	$ 40,065,532	$ 17,464,277	$ 20,073,473
Reconstruction	$ 68,243,244	$ 25,958,222	$ 39,035,009	$ 78,340,718	$ 23,251,260	$ 31,121,229
Total	**$ 274,350,258**	**$ 125,134,271**	**$ 119,285,181**	**$ 129,801,657**	**$ 48,057,176**	**$ 58,279,054**

Table 9: Total estimated local agency spending in 2016 adjusted for agencies that did not fully report IRT/ADARS data.

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ 1,879,283	$ 947,122	$ 2,448,788	$ 940,715	$ 769,151	$ 752,266
Heavy CPM	$ 59,631,151	$ 28,481,745	$ 13,967,270	$ 14,868,057	$ 6,191,721	$ 8,164,327
Rehabilitation	$ 149,574,769	$ 58,654,699	$ 47,176,165	$ 43,983,560	$ 23,929,362	$ 15,536,552
Reconstruction	$ 125,519,185	$ 39,280,005	$ 30,864,655	$ 51,047,438	$ 29,351,645	$ 23,080,899
Total	**$ 336,604,387**	**$ 127,363,571**	**$ 94,456,878**	**$ 110,839,770**	**$ 60,241,879**	**$ 47,534,044**

5.3 Evaluation of Local Agency Basis of Cost

Project cost data from the MDOT bid letting system is a resilient source of information on bid costs for federal aid road projects both at the state and local levels. This information can provide a useful comparison to IRT/ADARS cost data.

Information from MDOT's bid letting system provides project cost data that only represents contractor low bid cost for specific projects. The bid letting data does not include construction over or under-runs in the construction phase of the project. Current professional practice in Michigan indicates that low bid costs are routinely within +-10% of the final physical construction costs for most projects. While there may be outliers, +-10% is a typical planning threshold.

Bid letting data from local agency projects from 2016 were collected from MDOT's bid letting system. Projects identified as local agency projects were classified based on the project description into one of the TAMC's four project categories (reconstruction, rehabilitation, heavy preventive maintenance, light preventive maintenance). The total length of the project was estimated using the start and end point locations included in the project description. Google Earth and Google Street view were used to determine the number of pavement lanes within each project boundary to calculate a lane mile number for each project. Summary data from bid analysis is presented below in Table 10 below.

Table 10: Bid letting costs from 2016 lettings for locally owned federal aid eligible projects matched to ADARS projects in 2017.

	# of Projects	Lane Miles	Total Dollars	Dollars/LM	% of Total
Light CPM	1	$ 306.1	$ 622,610	$ 2,034	0.29%
Heavy CPM	22	$ 385.6	$ 12,174,076	$ 31,575	5.71%
Rehabilitation	136	$ 576.5	$ 98,348,397	$ 170,599	46.10%
Reconstruction	73	$ 140.0	$ 102,170,859	$ 729,844	47.90%
Totals	***232***	***1408.2***	***$ 213,315,943***		100%

The cost per lane mile averages for heavy CPM, rehabilitation, and reconstruction generated from bid letting exceed the averages generated for the federal aid network using IRT/ADARS reporting data. See section 5.1 and Appendix A for details on IRT/ADARS costs. This analysis is not a one-to-one comparison of projects, and it is likely that projects present in the MDOT bid letting system are of a more complex subset of the projects that are submitted in the IRT/ADARS system. These more complex projects would likely have a higher cost per lane mile. While this particular analysis is not conclusive, it is a trend that was investigated further with other techniques.

The relationship between IRT/ADARS costs and bid letting data was investigated by finding and comparing individual projects that were bid, constructed, and reported to TAMC through the IRT/ADARS system. Projects in the 2017 IRT data set were matched to their respective 2016 bid letting data. Project matches were identified based on the project's description in the bid letting system and the PR and mile point data from the IRT/ADARS system.

Only 57 reconstruction or rehabilitation projects are present in both the 2016 bid letting data and the 2017 IRT / ADARS data, which was expected since many federal aid project are bid several years before they would be reported in the IRT.

Matched pairs of bid letting data and IRT/ADARS data are presented in Table 11. The trend observed in the aggregate comparison of letting vs ADARS cost was again apparent when comparing the total let cost of these matched pairs of projects with their respective IRT/ADARS costs. The let costs of the matched pairs exceed the reported ADARS project costs for these projects.

Table 11: Bid letting costs and ADARS costs for matched reconstruction and rehabilitation pairs on locally owned, federal aid eligible projects.

Project Type	Number of projects	Total Let Cost	Total ADARS Cost
Reconstruction	21	27,199,199	23,149,232
Rehabilitation	36	25,629,326	24,807,865

The reported IRT/ADARS cost for each of the matched 57 projects were subtracted from the respective let cost to calculate a project by project cost difference. This cost difference was expressed as a percentage of the let cost for each of the 57 matching projects. Analysis of the magnitude of the difference between let-cost data and IRT-ADARS cost data for matched pairs of projects is illustrated in Figure 8 below.

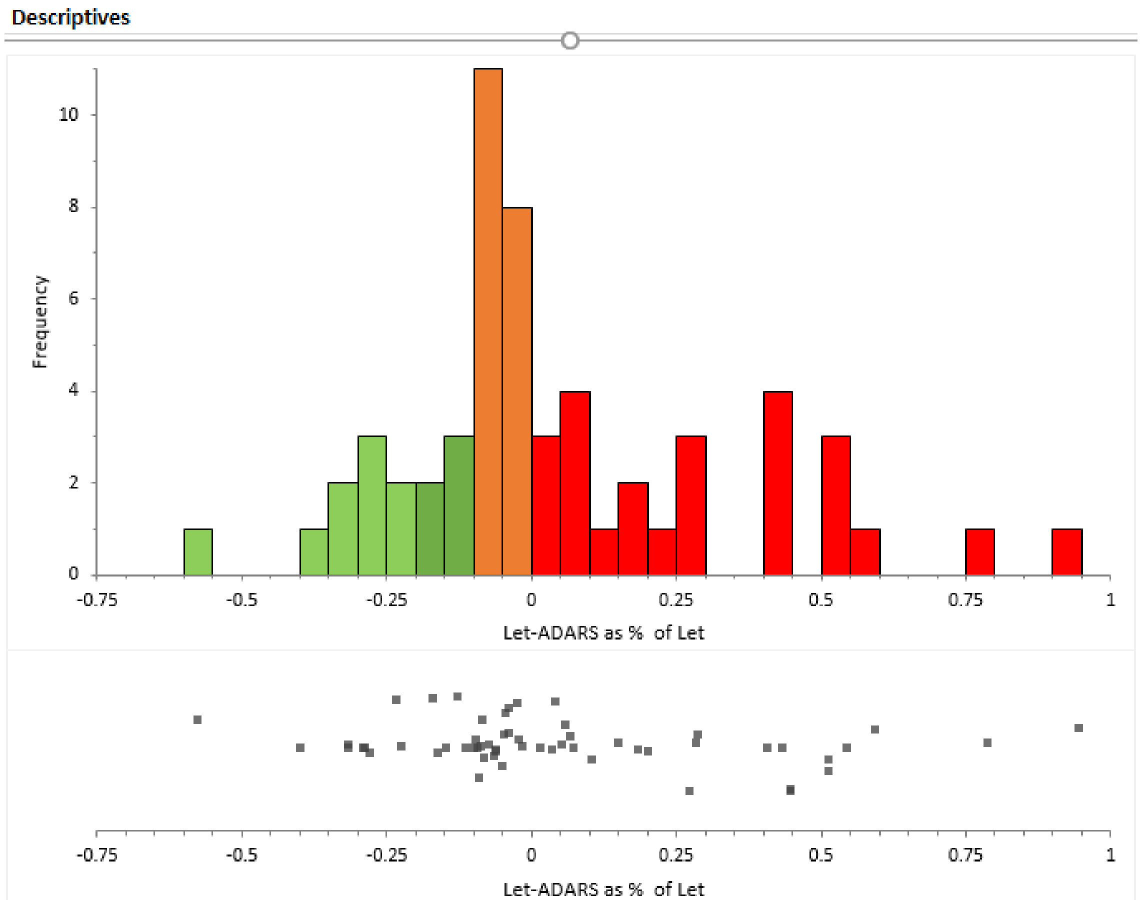


Figure 8: Frequency and box plot chart illustrating the percentage difference between let cost data and IRT/ADARS Cost data for matched pairs of projects.

NOTE: Negative scale means LET data is lower than IRT/ADARS data, positive scale means LET data is higher than IRT/ADARS data. Projects illustrated in green are within the expected range exceeding let costs. Projects illustrated in red are lower than expected IRT/ADARS costs when compared to Let data.

It is surprising to see the large portion of projects that had bid lettings in excess of the reported ADARS costs for the project. Some of these projects may be the result of bid savings, meaning the total quantity of pay items was less than estimated by the bid package, resulting in a lower total cost than the contractors bid. However, this would typically account for at most at 10% bid savings.

Bid letting costs do not include PE and CE costs for normal project delivery, so some or all of those costs should be included in IRT/ADARS reports depending on how cost reporting guidance is interpreted. Conservatively estimating PE may range from 10% to 16% of physical construction costs on reconstruction or rehabilitation projects. CE can account for an additional 11% to 16% on top of physical construction costs.

Interpreting the data shown in Figure 8 requires the creation of a reasonable threshold for comparison of let costs to final project costs considering sources of additive and subtractive expenses. It is feasible that project underruns could account for a savings of 10%, so the lowest reasonably expected physical construction cost could be 10% lower than the let cost. Including PE costs would add 10% or more to the physical construction costs, and CE would add another 11% or more to the physical construction cost. Therefore, let costs should be at least 1% under ADARS cost if only CE is included (ADARS cost = Let cost – 10% bid savings, +11% CE cost) and let cost should be 11% under the ADARS cost (ADARS cost = Let cost – 10% bid savings, +10 PE cost, + 11% CE cost) if both CE and PE are included.

Projects that have IRT/ADARS reported costs lower than their let costs are shown in red in Figure 8. These projects constitute 42% of the matched projects in this study. The criteria developed in the previous paragraph would indicate that these projects are outliers if CE costs were included in IRT/ADARS costs that were reported.

Matched pair projects that are shown in orange in Figure 8 constitute 33% of the total projects. These projects, in addition to the projects shown in red, constitute 75% of the matched pairs, and are considered to be outliers if both CE and PE are included in the IRT/ADARS costs.

At the far end of the spectrum there are 10% of the matched pair project that have IRT/ADARS costs that are less than half the let cost. These projects may be reporting errors that are a misunderstanding of the basis of cost, or they may represent data entry errors.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1.1 Project Cost Per Lane Mile

IRT data provides a wealth of cost information and project volume information that is useful for local agency, regional, and state planning. Compliance with the project reporting requirements are high, with an estimated 92% of the reported data useful for analysis without quality or completeness concerns. This should not be misconstrued as a measure of compliance, but rather a measure of data used by this study for analysis.

Project cost per lane mile data calculated from the IRT/ADARS data set appears to be resilient to the level of errors and inconsistencies observed in the entered data. This was tested by performing a sensitivity analysis on the cost per lane mile data.

Project cost per lane mile data from this study is comparable to the TAMC Treatment Cost Survey that was completed in 2008. The 2008 survey asked local agency staff to provide their planning costs for projects on a lane mile basis but did not evaluate any actual project data, and the definitions for preventive maintenance were slightly different than the current TAMC project classifications.

Data from the statewide project cost tables and project volume table from this report should be used as the basis for modeling local agency road networks. This data represents the best source of cost and treatment volume data available at the state level. The data should be calculated annually and combined in a three year rolling average data set to eliminate year to year changes that may occur due to a few large projects.

6.1.2 Basis of Cost Reporting

Analysis of MDOT bid letting system and IRT-ADARS total project costs for local agency projects indicates that it is likely that CE and PE costs are not being captured by local agency project reporting. This may be due to a misunderstanding of the basis of costs, or it could be due to the specifics of the accounting systems that local agencies use and how they track time and expenses. Work is therefore needed to better define and communicate to local agencies the basis of project cost reporting for ADARS, and specifically whether CE and PE should be included.

MDOT currently excludes right of way costs in their reporting to TAMC, whereas these costs are included in local agency data. These costs may not be significant at the state level, and MDOT likely has the ability to either estimate or directly report these costs. While this may not be a serious concern for the use of the data, the issue underlines the confusion over the basis of costs that are to be reported.

There is no right or wrong answer as far as including or excluding CE and PE costs, since methods exist for estimating their impact to an overall budget. However, agencies should be instructed to either include or exclude these costs to ensure consistency among agencies and between reporting systems.

6.1.3 Repeat Analysis

The TAMC's focus on gaining compliance with reporting requirements appears to be paying off in terms of the data that is being produced in the IRT. Successive years of IRT data will allow TAMC to separate year to year trends from background noise much like successive years of PASER data have done for forecasting on the overall trajectory of the paved federal aid eligible road system.

It is recommended that the analysis in this study be rerun every two years as normal TAMC business process. Data handling routines should be set up with the help of CSS to automate data processing following the general form of the analysis in this report.

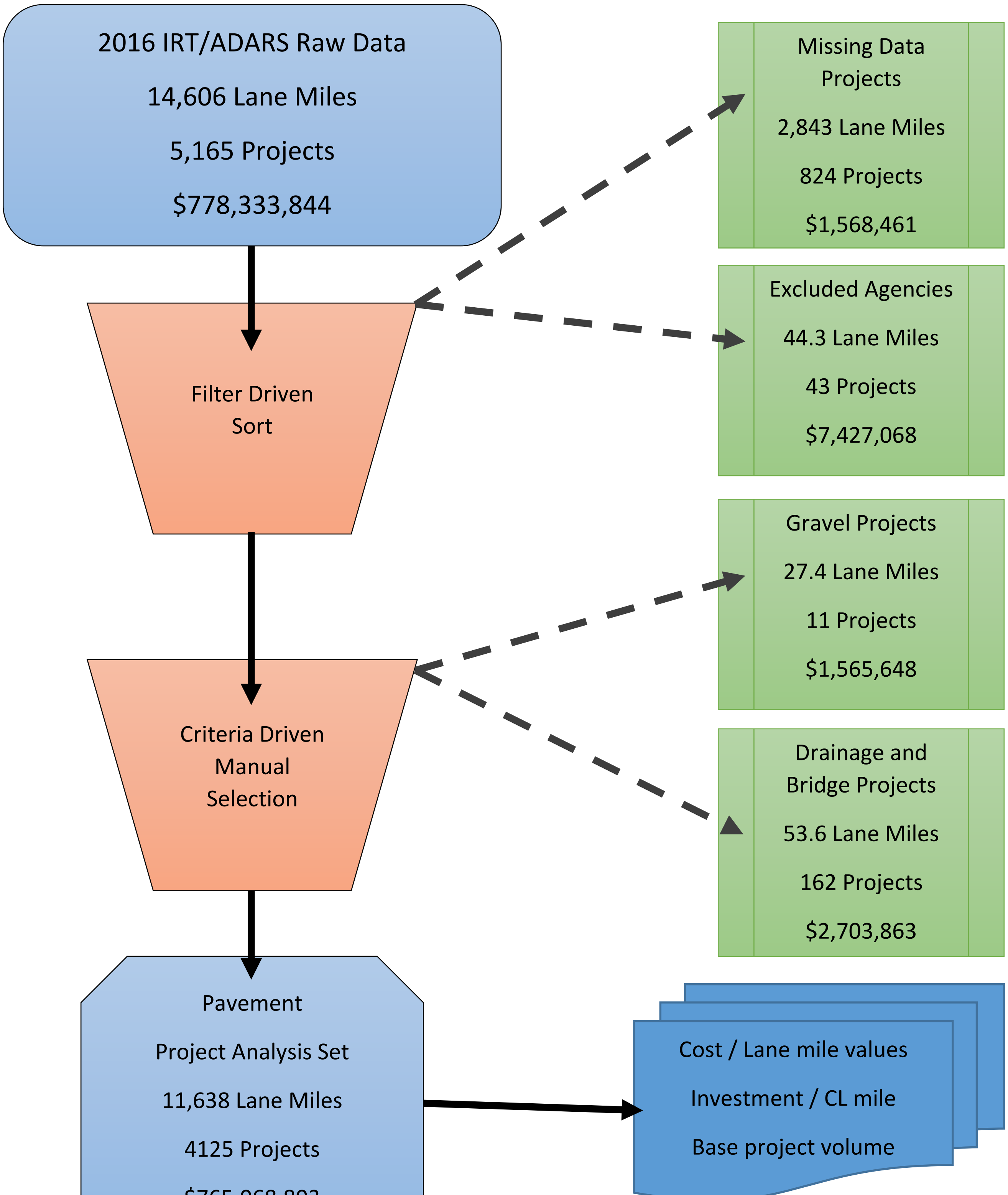
7 REFERENCES

WashDOT (2002). *Highway Construction Cost Comparision Survey.* Washington State Department of Transportation.

Hollar, D. (2011). *Predicting Preliminary Engineering Costs for Highway Projects.* Raleigh, North Carolina: North Carolina State University.

Hummer, J. E., Liu, M., & Rasdorf, W. J. (2011). *Preliminary Engineering Cost Trends for Highway Projects.* Raleigh Corth Carolina: North Carolina State University.

APPENDIX A: DATABASE FILTERING STATISTICS FOR 2016


2016 IRT/ADARS Raw Data
14,606 Lane Miles
5,165 Projects
$778,333,844
Filter Driven
Sort
Missing Data
Projects
2,843 Lane Miles
824 Projects
$1,568,461
Excluded Agencies
44.3 Lane Miles
43 Projects
$7,427,068
Criteria Driven
Manual
Selection
Gravel Projects
27.4 Lane Miles
11 Projects
$1,565,648
Drainage and
Bridge Projects
53.6 Lane Miles
162 Projects
$2,703,863
Pavement
Project Analysis Set
11,638 Lane Miles
4125 Projects
$765,068,803
Cost / Lane mile values
Investment / CL mile
Base project volume

APPENDIX B COST PER LANE MILE TABLES AND GRAPHS

2017 IRT/ADARD Data

All Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Total	Dollars/LM
Light CPM	837	2,264.2	$ 10,840,529	1.55%	$ 4,788
Heavy CPM	1,756	5,547.3	$ 115,921,824	16.63%	$ 20,897
Rehabilitation	1,218	2,766.2	$ 321,777,460	46.15%	$ 116,326
Reconstruction	484	711.5	$ 248,712,003	35.67%	$ 349,545
Totals	***4,295***	***11,289.1***	***$ 697,251,816***		

Federal Aid Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	400	1,672.5	$ 7,551,626	2%	$ 4,515
Heavy CPM	572	3,343.0	$ 67,114,433	17%	$ 20,076
Rehabilitation	419	1,600.7	$ 208,974,236	52%	$ 130,552
Reconstruction	168	350.7	$ 120,087,742	30%	$ 342,451
Totals	***1,559***	***6,966.9***	***$ 403,728,036***	100%	

Non Federal Aid Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	437	591.6	$ 3,288,903	1%	$ 5,559
Heavy CPM	1,184	2,204.2	$ 48,807,391	17%	$ 22,143
Rehabilitation	799	1,165.5	$ 112,803,224	38%	$ 96,787
Reconstruction	316	360.9	$ 128,624,260	44%	$ 356,439
Totals	***2,736***	***4,322.2***	***$ 293,523,779***	100%	

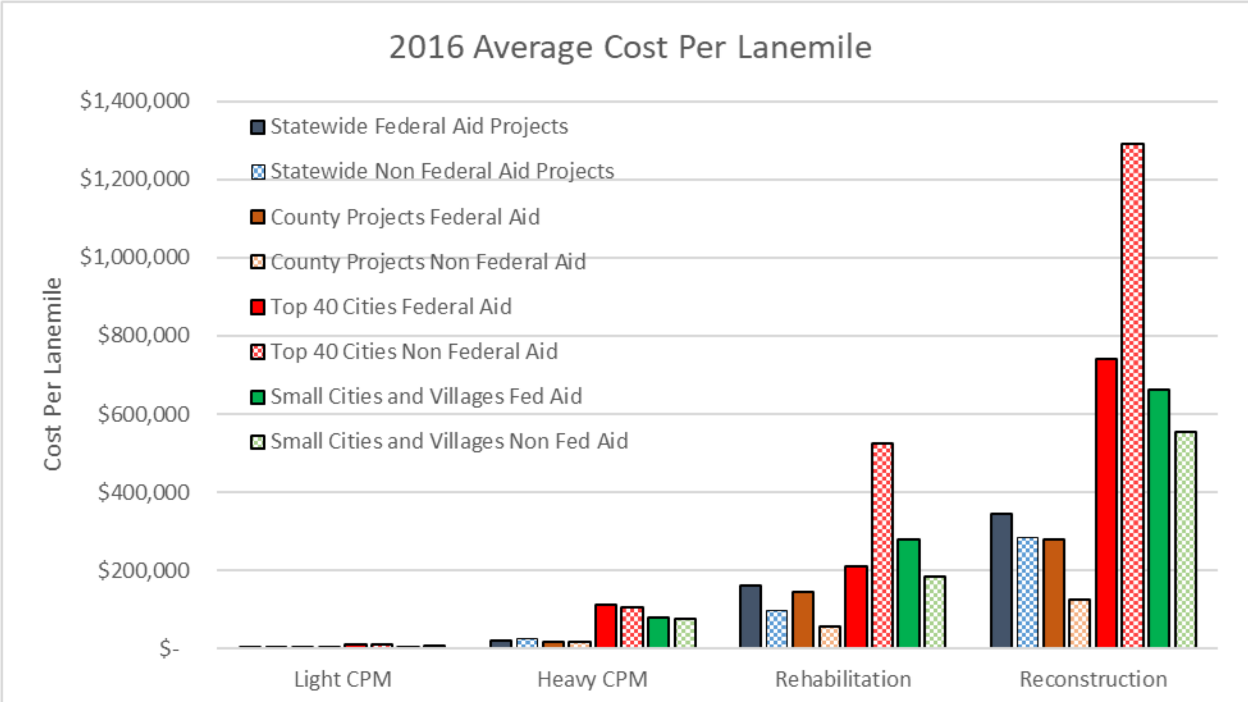
County Projects					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	245	1,178.2	$ 4,778,365	2%	$ 4,056
Heavy CPM	456	3,133.3	$ 50,429,678	21%	$ 16,095
Rehabilitation	300	1,260.8	$ 128,352,115	53%	$ 101,801
Reconstruction	88	267.7	$ 60,777,848	25%	$ 227,066
Totals	***1,089***	***5,840.0***	***$ 244,338,006***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	161	400.4	$ 1,983,191	2%	$ 4,953
Heavy CPM	719	1,963.9	$ 32,397,339	29%	$ 16,496
Rehabilitation	481	903.2	$ 55,075,249	49%	$ 60,978
Reconstruction	137	242.4	$ 23,414,050	21%	$ 96,597
Totals	***1,498***	***3,509.9***	***$ 112,869,829***	100%	

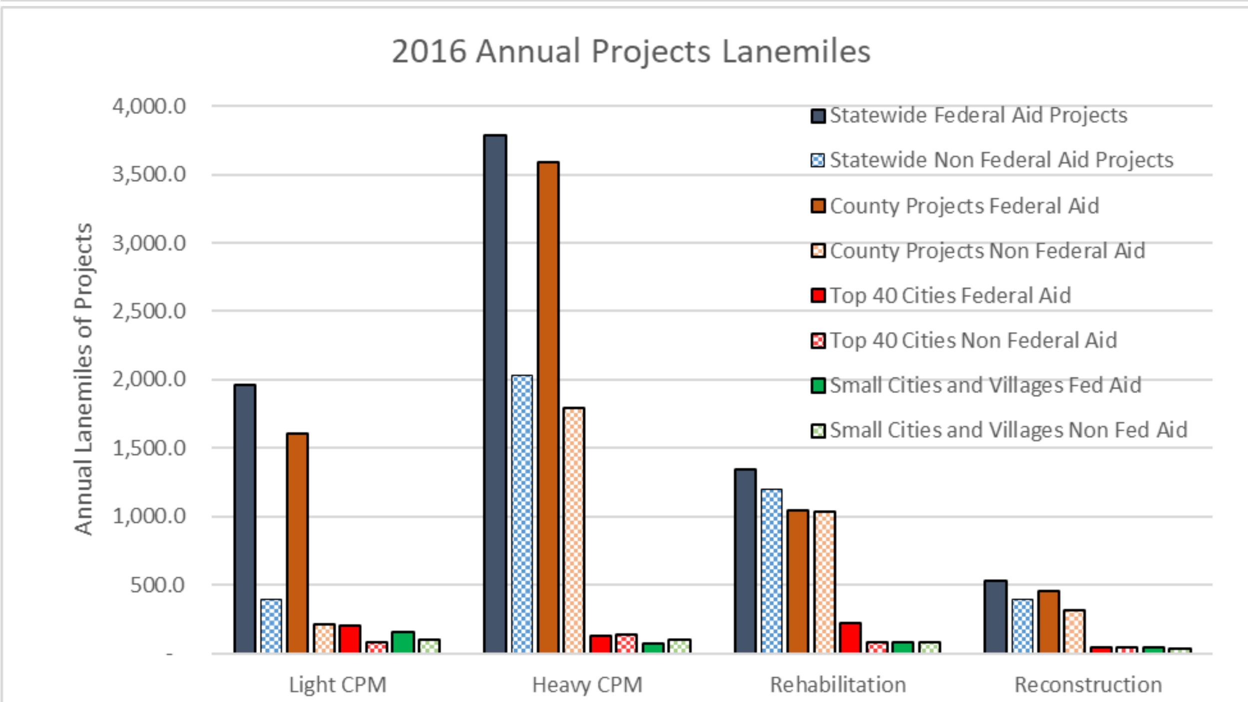
Top 40 Cities					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	72	199.4	$ 2,104,751	2%	$ 10,555
Heavy CPM	59	144.3	$ 10,376,560	9%	$ 71,891
Rehabilitation	52	269.6	$ 64,025,947	56%	$ 237,462
Reconstruction	26	42.3	$ 37,214,394	33%	$ 880,752
Totals	***209***	***655.6***	***$ 113,721,652***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	128	104.1	$ 749,630	1%	$ 7,201
Heavy CPM	316	152.9	$ 10,284,936	8%	$ 67,251
Rehabilitation	164	160.9	$ 38,796,835	31%	$ 241,170
Reconstruction	68	63.3	$ 75,860,016	60%	$ 1,198,534
Totals	***676***	***481.2***	***$ 125,691,417***	100%	

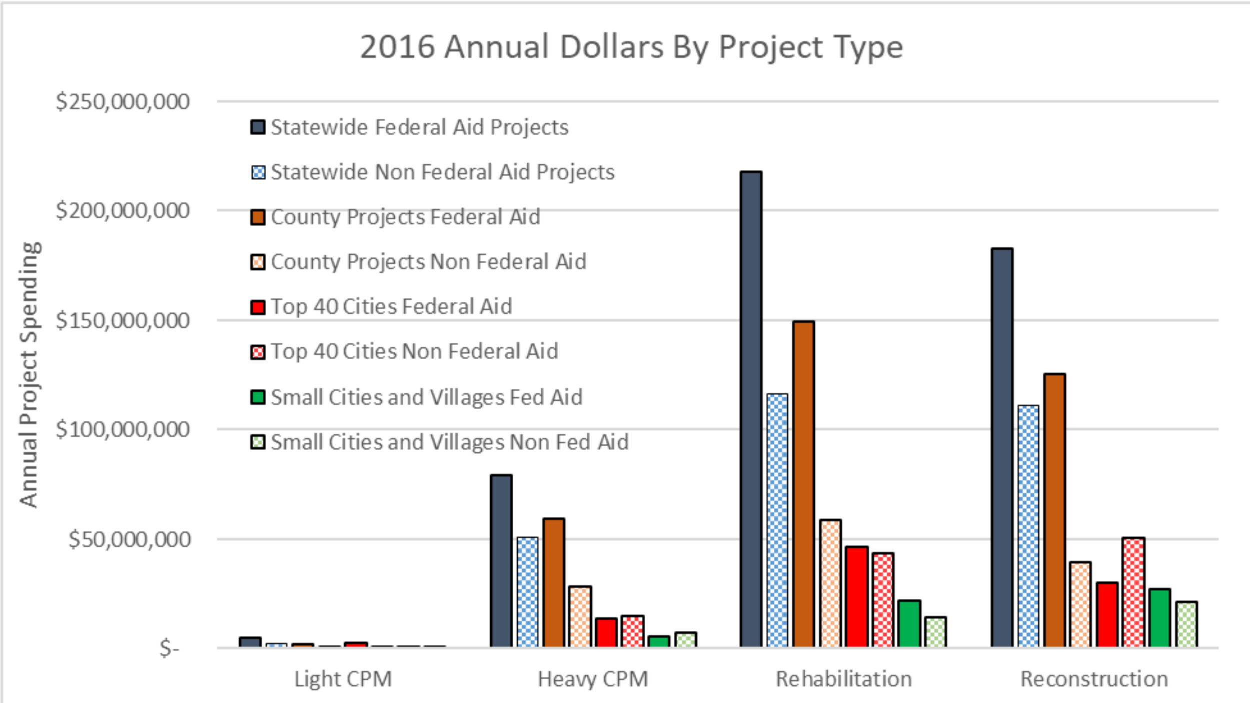
Small Cities and Villages					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	83	294.9	$ 668,510	1%	$ 2,267
Heavy CPM	57	65.4	$ 6,308,195	14%	$ 96,526
Rehabilitation	67	70.3	$ 16,596,174	36%	$ 236,204
Reconstruction	54	40.8	$ 22,095,500	48%	$ 542,194
Totals	***261***	***471.3***	***$ 45,668,378***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	148	87.1	$ 556,083	1%	$ 6,385
Heavy CPM	149	87.4	$ 6,125,116	11%	$ 70,115
Rehabilitation	154	101.4	$ 18,931,140	34%	$ 186,685
Reconstruction	111	55.2	$ 29,350,195	53%	$ 531,947
Totals	***562***	***331.0***	***$ 54,962,533***	100%	

2016 IRT/ADARS Data

All Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Total	Dollars/LM
Light CPM	548	2,360.8	$ 7,555,942	1%	$ 3,201
Heavy CPM	1,771	5,813.0	$ 129,681,594	17%	$ 22,309
Rehabilitation	1,305	2,541.4	$ 334,206,901	44%	$ 131,507
Reconstruction	501	923.0	$ 293,624,367	38%	$ 318,128
Totals	***4,125***	***11,638.2***	***$ 765,068,803***	100%	
Federal Aid Projects STATEWIDE					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	245	1,963.1	$ 4,990,122	1%	$ 2,542
Heavy CPM	709	3,783.3	$ 79,030,618	16%	$ 20,889
Rehabilitation	401	1,344.0	$ 217,866,477	45%	$ 162,104
Reconstruction	174	533.0	$ 182,766,408	38%	$ 342,887
Totals	***1,529***	***7,623.5***	***$ 484,653,625***	100%	
Non Federal Aid Projects STATEWIDE					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	303	397.7	$ 2,565,820	1%	$ 6,451
Heavy CPM	1,062	2,029.7	$ 50,650,976	18%	$ 24,955
Rehabilitation	904	1,197.4	$ 116,340,423	41%	$ 97,163
Reconstruction	327	390.0	$ 110,857,959	40%	$ 284,285
Totals	***2,596***	***4,014.8***	***$ 280,415,178***	100%	
County Projects					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	121	1,607.4	$ 1,879,283	1%	$ 1,169
Heavy CPM	602	3,588.3	$ 59,631,151	18%	$ 16,618
Rehabilitation	283	1,045.3	$ 149,574,769	44%	$ 143,097
Reconstruction	115	451.3	$ 125,519,185	37%	$ 278,111
Totals	***1,121***	***6,692.3***	***$ 336,604,387***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	100	212.4	$ 947,122	1%	$ 4,460
Heavy CPM	826	1,792.6	$ 28,481,745	22%	$ 15,888
Rehabilitation	664	1,037.2	$ 58,654,699	46%	$ 56,550
Reconstruction	208	312.6	$ 39,280,005	31%	$ 125,671
Totals	***1,798***	***3,354.8***	***$ 127,363,571***	100%	
Top 40 Cities					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	70	200.3	$ 2,405,044	3%	$ 12,006
Heavy CPM	52	123.5	$ 13,717,764	15%	$ 111,067
Rehabilitation	56	219.8	$ 46,333,430	50%	$ 210,806
Reconstruction	21	41.0	$ 30,313,301	33%	$ 739,656
Totals	***199***	***584.6***	***$ 92,769,540***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	85	83.0	$ 929,214	1%	$ 11,197
Heavy CPM	86	139.4	$ 14,686,281	13%	$ 105,375
Rehabilitation	90	83.1	$ 43,445,820	40%	$ 523,003
Reconstruction	46	39.1	$ 50,423,336	46%	$ 1,289,336
Totals	***307***	***344.5***	***$ 109,484,651***	100%	
Small Cities and Villages					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	54	155.4	$ 705,795	1%	$ 4,542
Heavy CPM	55	71.6	$ 5,681,703	10%	$ 79,407
Rehabilitation	62	78.9	$ 21,958,278	40%	$ 278,185
Reconstruction	38	40.7	$ 26,933,922	49%	$ 661,572
Totals	***209***	***346.6***	***$ 55,279,698***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	118	102.3	$ 689,484	2%	$ 6,737
Heavy CPM	150	97.7	$ 7,482,950	17%	$ 76,577
Rehabilitation	150	77.1	$ 14,239,905	33%	$ 184,711
Reconstruction	73	38.3	$ 21,154,618	49%	$ 552,585
Totals	***491***	***315.4***	***$ 43,566,956***	100%	


2016 Average Cost Per Lanemile
Cost Per Lanemile
$1,400,000
$1,200,000
$1,000,000
$800,000
$600,000
$400,000
$200,000
$-
Statewide Federal Aid Projects
Statewide Non Federal Aid Projects
County Projects Federal Aid
County Projects Non Federal Aid
Top 40 Cities Federal Aid
Top 40 Cities Non Federal Aid
Small Cities and Villages Fed Aid
Small Cities and Villages Non Fed Aid
Light CPM
Heavy CPM
Rehabilitation
Reconstruction


2016 Annual Projects Lanemiles
Annual Lanemiles of Projects
4,000.0
3,500.0
3,000.0
2,500.0
2,000.0
1,500.0
1,000.0
500.0
-
Statewide Federal Aid Projects
Statewide Non Federal Aid Projects
County Projects Federal Aid
County Projects Non Federal Aid
Top 40 Cities Federal Aid
Top 40 Cities Non Federal Aid
Small Cities and Villages Fed Aid
Small Cities and Villages Non Fed Aid
Light CPM
Heavy CPM
Rehabilitation
Reconstruction


2016 Annual Dollars By Project Type
$250,000,000
$200,000,000
$150,000,000
$100,000,000
$50,000,000
$-
Annual Project Spending
Statewide Federal Aid Projects
Statewide Non Federal Aid Projects
County Projects Federal Aid
County Projects Non Federal Aid
Top 40 Cities Federal Aid
Top 40 Cities Non Federal Aid
Small Cities and Villages Fed Aid
Small Cities and Villages Non Fed Aid
Light CPM
Heavy CPM
Rehabilitation
Reconstruction

APPENDIX C: AVERAGE WEIGHTED COST PER LANE MILE FOR COMMON TREATMENTS

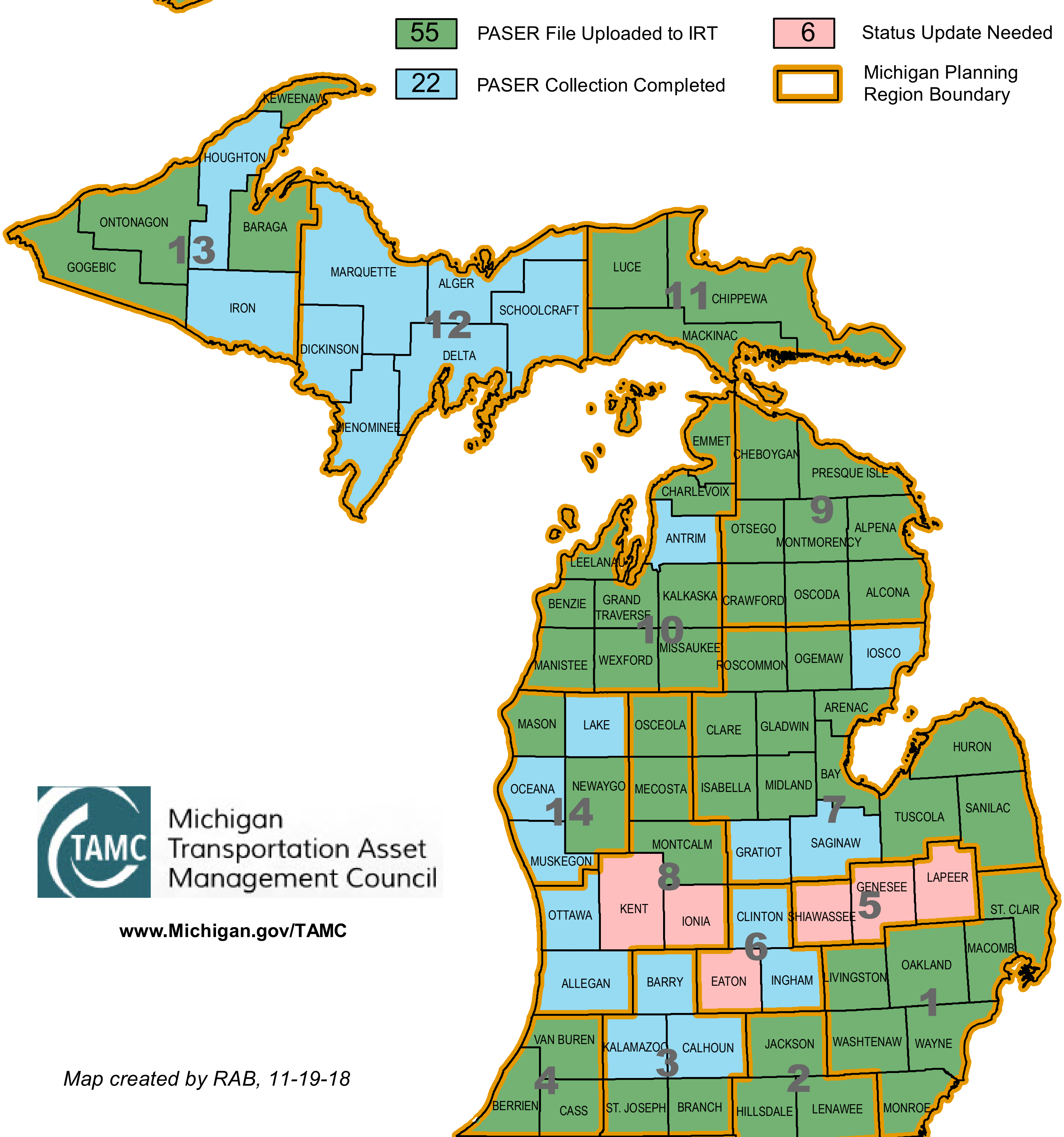
2016 & 2017 County Projects					
TAMC Class	Project Subcategory	# of Projects	Lane Miles	Total Project Dollars	$/LM
Heavy CPM	Chip Seal	1809	7775.7	$ 94,362,306	$ 12,136
Heavy CPM	Slurry or Cape Seal	68	438.3	$ 7,550,493	$ 17,228
Heavy CPM	Micro Surfacing	56	205.1	$ 6,422,093	$ 31,312
Heavy CPM	Ultra Thin Overlay	98	271.6	$ 10,034,560	$ 36,951
Heavy CPM	Mill and Fill - Non Structural	143	188.3	$ 14,153,379	$ 75,145
Heavy CPM	Overlay - Non Structural	439	946.0	$ 42,039,080	$ 44,439
Rehabilitation	Mill and Fill - Structural	88	220.2	$ 24,929,138	$ 113,215
Rehabilitation	Overlay - Structural	507	968.0	$ 85,237,119	$ 88,058
Rehabilitation	Crush and Shape	302	818.5	$ 116,191,356	$ 141,963
Rehabilitation	Minor Rehab	112	223.7	$ 5,534,475	$ 24,741
Rehabilitation	Major Rehab	48	333.9	$ 40,293,758	$ 120,660
Rehabilitation	Resurfacing	471	1222.3	$ 90,615,807	$ 74,138
Reconstruction	Reconstruction	372	814.6	$ 212,347,535	$ 260,664

2016 & 2017 Top 40 City Projects					
TAMC Class	Project Subcategory	# of Projects	Lane Miles	Total Project Dollars	$/LM
Heavy CPM	Chip Seal	50	98.8	$ 1,737,572	$ 17,583
Heavy CPM	Slurry or Cape Seal	5	46.5	$ 1,629,774	$ 35,032
Heavy CPM	Micro Surfacing	175	63.3	$ 2,239,182	$ 35,376
Heavy CPM	Ultra Thin Overlay	0	0.0	$ -	
Heavy CPM	Mill and Fill - Non Structural	68	95.1	$ 13,591,431	$ 142,889
Heavy CPM	Overlay - Non Structural	147	131.8	$ 14,958,746	$ 113,476
Rehabilitation	Mill and Fill - Structural	43	39.9	$ 10,428,611	$ 261,055
Rehabilitation	Overlay - Structural	33	58.0	$ 14,307,971	$ 246,685
Rehabilitation	Crush and Shape	54	50.1	$ 13,729,087	$ 273,941
Rehabilitation	Minor Rehab	16	76.9	$ 13,290,333	$ 172,833
Rehabilitation	Major Rehab	10	7.4	$ 9,525,478	$ 1,287,923
Rehabilitation	Resurfacing	168	412.6	$ 120,693,726	$ 292,551
Reconstruction	Reconstruction	144	155.5	$ 131,429,497	$ 845,445

2016 & 2017 Small City and Village Projects					
TAMC Class	Project Subcategory	# of Projects	Lane Miles	Total Project Dollars	$/LM
Heavy CPM	Chip Seal	59	62.7	$ 1,155,266	$ 18,420
Heavy CPM	Slurry or Cape Seal	39	25.3	$ 781,106	$ 30,854
Heavy CPM	Micro Surfacing	2	2.3	$ 78,078	$ 33,467
Heavy CPM	Ultra Thin Overlay	17	16.5	$ 560,961	$ 33,971
Heavy CPM	Mill and Fill - Non Structural	201	153.5	$ 17,201,496	$ 112,046
Heavy CPM	Overlay - Non Structural	66	55.2	$ 6,982,696	$ 126,489
Rehabilitation	Mill and Fill - Structural	49	24.7	$ 3,529,286	$ 143,071
Rehabilitation	Overlay - Structural	26	18.3	$ 1,797,943	$ 98,179
Rehabilitation	Crush and Shape	118	72.0	$ 13,808,523	$ 191,710
Rehabilitation	Minor Rehab	14	7.6	$ 1,944,668	$ 256,316
Rehabilitation	Major Rehab	43	31.7	$ 13,062,479	$ 412,118
Rehabilitation	Resurfacing	171	127.3	$ 31,558,648	$ 247,845
Reconstruction	Reconstruction	250	156.8	$ 91,861,717	$ 586,021

2018 - PASER Status by County As of November 19

Map indicates completion status of TAMC sponsored Federal Aid PASER Data Collection as reported by Regional Planning Agency Coordinators. Data also includes updates from previous calls and from quarterly reports found with invoices and IRT files uploaded up to November 19, 2018.



Michigan Transportation Asset Management Council

www.Michigan.gov/TAMC

Map created by RAB, 11-19-18

STATE OF MICHIGAN

RICK SNYDER
GOVERNOR

Michigan Transportation Asset Management Council

JOANNA I. JOHNSON
CHAIR

November 20, 2018

Public Act 51 Agencies
(Address from ADARS Contact list)

RE: Public Act 325 of 2018 Asset Management Plan Schedule

Dear Local Road Agency Partners,

On behalf of the Michigan Transportation Asset Management Council (TAMC) we want to provide you another update on Public Act (PA) 325, which was enacted in July 2018. Previously you received a letter sharing information and timelines related to Transportation Asset Management Plans (TAMPs).

PA 325 modifies TAMC's program to include requirements for asset management plans from local road agencies. No later than October 1, 2019, the TAMC shall develop a template for an asset management plan for use by local road agencies responsible for 100 or more certified miles of road and require its submission to the TAMC. No later than October 1, 2019, the TAMC shall establish a schedule for the submission of asset management plans by local road agencies that ensures that 1/3 of these local road agencies submit an asset management plan each year. As we previously shared, the TAMC was working on establishing the submission schedule and has sought feedback from member agencies.

TAMC TAMP Submission Schedule

We are now pleased to share that at its November 7, 2018 TAMC meeting, the TAMC determined the following schedule for TAMP submittals. It was important we provide this information as soon as possible for local agency planning and support. ***Please note, local road agencies can volunteer to advance to an earlier year, however cannot delay to a later year.*** Also note, the Michigan Department of Transportation (MDOT) is not listed in this schedule as the Federal Highway Administration provides oversight of TAMPs coming from state transportation departments, therefore MDOT is not subject to this PA 325 requirement. Lastly, if your agency is not listed on this schedule, your agency is not required to submit a TAMP under this legislation. However, TAMC does encourage all road agencies to utilize our training programs, plan templates and processes to assist you in management of your road system.

Roger Belknap – Transportation Asset Management Council Coordinator
MURRAY D. VAN WAGONER BUILDING • P.O. BOX 30050 • LANSING, MICHIGAN 48909
www.michigan.gov/tamc • (517) 335-4580

October 1, 2020		October 1, 2021		October 1, 2022	
1	City of Wyoming	1	Wexford County	1	City of Westland
2	Wayne County	2	Washtenaw County	2	City of Warren
3	City of Walker	3	Van Buren County	3	Tuscola County
4	City of Troy	4	City of Taylor	4	City of Sterling Heights
5	St. Joseph County	5	City of St. Clair Shores	5	St. Clair County
6	City of Southfield	6	Shiawassee County	6	Schoolcraft County
7	Sanilac County	7	City of Saginaw	7	Saginaw County
8	City of Royal Oak	8	City of Roseville	8	Roscommon County
9	City of Romulus	9	City of Rochester Hills	9	Presque Isle County
10	City of Portage	10	City of Port Huron	10	City of Pontiac
11	Ottawa County	11	Otsego County	11	Oscoda County
12	Osceola County	12	Ontonagon County	12	Ogemaw County
13	Oceana County	13	Oakland County	13	City of Novi
14	City of Norton Shores	14	Newaygo County	14	City of Muskegon
15	Muskegon County	15	Montmorency County	15	Montcalm County
16	Monroe County	16	Missaukee County	16	City of Midland
17	Midland County	17	Menominee County	17	Mecosta County
18	Mason County	18	Marquette County	18	Manistee County
19	Macomb County	19	Mackinac County	19	Luce County
20	City of Livonia	20	Livingston County	20	City of Lincoln Park
21	Lenawee County	21	Leelanau County	21	Lapeer County
22	City of Lansing	22	Lake County	22	Keweenaw County
23	City of Kentwood	23	Kent County	23	Kalkaska County
24	Kalamazoo County	24	City of Kalamazoo	24	Jackson County
25	City of Jackson	25	Isabella County	25	Iron County
26	Iosco County	26	Ionia County	26	Ingham County
27	Huron County	27	Houghton County	27	City of Holland
28	Hillsdale County	28	Gratiot County	28	Grand Traverse County
29	City of Grand Rapids	29	Gogebic County	29	Gladwin County
30	Genesee County	30	City Garden City	30	City of Flint
31	City of Farmington Hills	31	Emmet County	31	Eaton County
32	Dickinson County	32	City of Detroit	32	Delta County
33	City of Dearborn Heights	33	City of Dearborn	33	Crawford County
34	Clinton County	34	Clare County	34	Chippewa County
35	Cheboygan County	35	Charlevoix County	35	Cass County
36	Calhoun County	36	City of Burton	36	Branch County
37	Berrien County	37	Benzie County	37	City of Bay City
38	Bay County	38	City of Battle Creek	38	Barry County
39	Baraga County	39	Arenac County	39	Antrim County
40	City of Ann Arbor	40	Alpena County	40	Allegan County
41	Alger County	41	Alcona County		

TAMC Efforts

TAMC provides a template for TAMPs and it is available on its website. This template is being modified to comply with the new law. In addition, TAMC is working with Michigan Technological University (MTU) to provide formal training for TAMP development with modules designed to assist agencies in completing the required plan elements. There are now training schedules available that can be found on the Center for Technology and Training website.

When TAMPs begin to be submitted in 2020, the TAMC shall review the TAMPs that are submitted and shall compare them to the minimum requirements of the law and the template created by the TAMC to determine whether the TAMP complies with those standards. If the TAMP does not meet those standards, the TAMC shall seek concurrence from MDOT that the TAMP does not meet the TAMC's standards.

Beginning October 1, 2025, if the TAMC determines, and MDOT concurs, that a local road agency has not demonstrated progress toward achieving the condition goals described in its TAMP for its federal-aid eligible county primary road system or city major street system, as applicable, the TAMC shall provide notice to the local road agency of the reasons that it has determined progress is not being made and recommendations on how to make progress toward the local road agency's condition goals. The local road agency shall become compliant within 6 months after receiving the notification.

If you have further questions or concerns, I encourage you to bring them to the attention of any of the members of the TAMC or support staff, and we will do our best to get you an appropriate response. Please take the time to attend the many training sessions offered for continued success in TAMPs. We thank you for all your efforts.

If you have any questions, please don't hesitate to contact me at (269) 381-3170.

Sincerely,

Joanna I. Johnson, Chair

CC: TAMC Members and Member Agencies